# COMPRESSED AIR MAGAZINE

GENERAL LIBRARY
UNIV. OF MICH.,
NOV 13 1911

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. XVI NOVEMBER, 1911 No. 11

**Compressors**
**Rock Drills**
**Coal Cutters**
**Air Tools**
**Air Hoists**
**Core Drills**

The reputation for quality enjoyed by Ingersoll-Rand Products is the natural result of forty years devoted to the construction of air power machinery representing the highest possible value to the buyer. That reputation is the security of every Ingersoll-Rand customer. Are you protected?

**INGERSOLL-RAND CO.**

11 BROADWAY, NEW YORK
165 QUEEN VICTORIA ST., LONDON

Published by THE COMPRESSED AIR MAGAZINE CO., Easton, Pa.
NEW YORK, Bowling Green Building LONDON, 165 Queen Victoria Street

Classified Buyers' Guide, Page 12. Index to Advertisers, Page 8.

Trade Mark
LUBROLEINE

# LUBROLEINE OILS

The world's standard lubricants for machinery propelled by compressed air.

**Lubroleine-Air-Cylinder Oil,**
(non-carbonizing)
**Lubroleine Air Drill Oil,**

**Lubroleine-B-Steam Cylinder Oil,**
**Lubroleine Steam Drill Oil,**

**Lubroleine-B-Engine Oil,**
(for vertical compressors and electric drills).

**Write for prices and full information.**

## Fiske Brothers Refining Company

ESTABLISHED 1870

**New York, U. S. A.**

Cable Address: "LUBROLEINE."

# Goodrich Hose

**FOR MECHANICAL USE**

## Air Drill Hose
## Steam Hose
## Pneumatic Tool Hose

Distinguished by

**The Mark of Quality**

MANUFACTURED BY

**The B. F. Goodrich Co., Akron, Ohio**

CHICAGO PHILADELPHIA BOSTON ST. LOUIS DENVER DETROIT
KANSAS CITY MINNEAPOLIS PITTSBURG ATLANTA
CLEVELAND PARIS LONDON

Our Products are also handled in
NEW YORK by BUFFALO

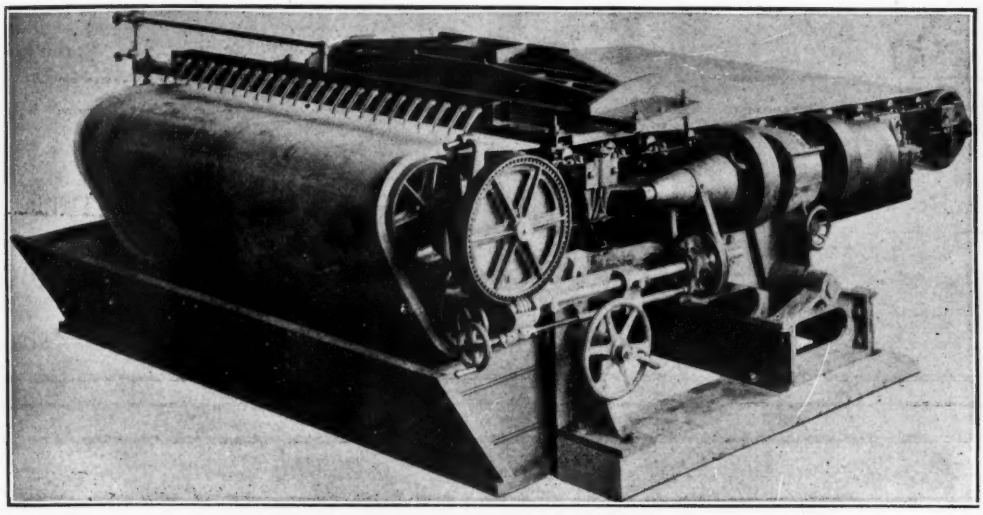
THE B. F. GOODRICH COMPANY OF NEW YORK

and in

SAN FRANCISCO LOS ANGELES SEATTLE

# The Isbell Vanner

Is being adopted by all modern concentrating mills where up-to-date equipment and close saving, combined with economy of operation, are sought for.



The **Isbell Vanner** is as far in advance, from both a mechanical and metallurgical standpoint, of the present type of vanning machines. as the present day percussion table is ahead of the old Gilpin County Bumper.

Adopted by one of the largest concentrating plants now in course of construction.

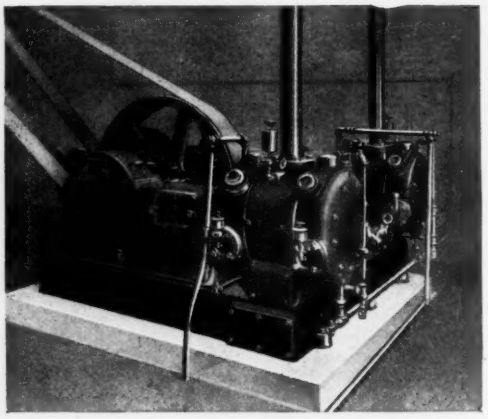
*Send for Bulletin No. 700.*

## THE GALIGHER MACHINERY COMPANY

**Manufacturers and Sole Agents**

**J. E. GALIGHER, Manager** **SALT LAKE CITY, UTAH**

# YOUR AIR SERVICE



will be dependable and efficient if the compressor is a "Sullivan."

You can rely on Sullivan Power Driven Air Compressors to run steadily, year in, year out, at lowest cost for power, labor and repairs.

This cut shows a Sullivan duplex, motor driven, heavy duty, self-oiling unit, for low pressures, used in vaporing fuel oil.

Sullivan Compressors of this compact and substantial type, with simple or compound cylinders, are available in a wide variety of capacities and pressures, for belt or direct connection.

*Ask for Bulletin* 958-*G.*

**Rock Drills** **Diamond Drills** **Hoists** **Hammer Drills**

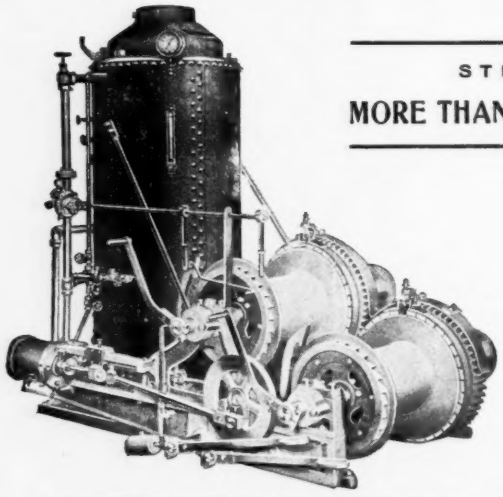
## Sullivan Machinery Co.

Butte, Mont.
Birmingham, Ala.
Boston, Mass.
Cobalt, Ont.
Denver, Colo.
El Paso
Joplin, Mo.
Knoxville
London

122 So. MICHIGAN AVE.
CHICAGO, ILL.

Nelson, B. C.
New York
Pittsburg,
Paris, France
St. Louis
San Francisco
Salt Lake
Seattle
Spokane
Sydney, Aust.

# Lidgerwood Hoisting Engines



LIDGERWOOD STANDARD CONTRACTOR'S HOIST

STEAM AND ELECTRIC

MORE THAN 300 REGULAR STYLES and SIZES

All made by the duplicate part system and contain many **Special Features** which commend them to the operator and owner because of their ease and facility of operation.

PATENT CORK INSERT FRICTIONS

Special Hoists for Mines, Quarries, Car Hauling, etc., up to 1,000 H. P., built to order.

## Lidgerwood Mfg. Co., 96 Liberty St., New York, N. Y.

*The Slogan of the Cameron:—"Character: The Grandest Thing."*

# CAMERON PUMPS

## Gritty Water and Limited Space

This combination can be easily and successfully handled by the use of CAMERON REMOVABLE BUSHING PATTERN PUMP.

The Removable Bushing is of iron or composition, which can be turned within the water cylinder as it wears, greatly increasing the length of service, and just as greatly decreasing the cost of maintenance.

In buying this pump you buy a pump that is backed by 50 years' experience—that has proven its reliabilty under every condition of service.

If you want to pay the lowest price for a pump that will give you continuous high efficiency with the least attention and care, install the CAMERON.

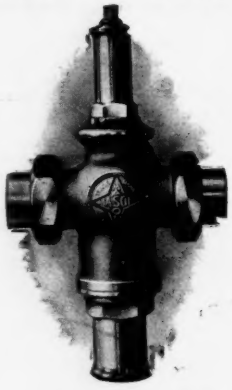
*Catalog No. 11 Illustrating and Describing all types of Cameron Pumps, sent on request to interested pump users*

## A. S. CAMERON STEAM PUMP WORKS

FOOT OF EAST TWENTY-THIRD STREET, NEW YORK

# MASON
# Reducing Valves

ARE THE WORLD'S STANDARD



Will reduce and maintain an even pressure of

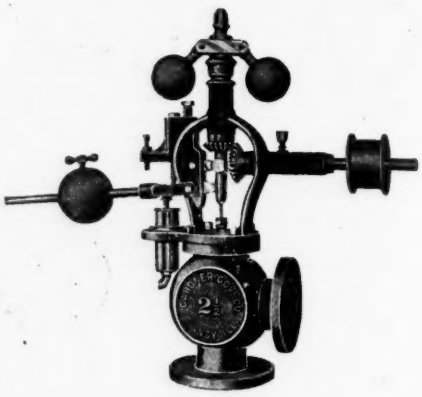
**Steam, Air or Water**

WRITE FOR NEW CATALOGUE

**Mason Regulator Co.**

**Boston, Mass., U. S. A.**

## The Gardner
### Speed and Pressure Regulator
**for Steam Actuated Air Compressors.**



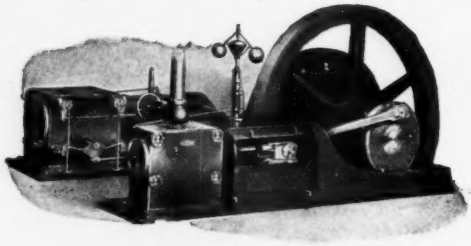
Represent over half a century of experience in Engine regulation. A regulator of merit and used by the largest compressor manufacturers.

*ASK FOR FURTHER PARTICULARS*

**THE GARDNER GOVERNOR CO.**
**QUINCY, ILL.**

# THE COOPER CORLISS

ALL SIZES AND TYPES.



WRITE FOR OUR BOOKLET

BUILT BY

# The C. & G. Cooper Co.

Home Office and Works — MT. VERNON, Ohio

BRANCH OFFICES:

NEW YORK, 1419 Bowling Green Building
BOSTON, 201 Devonshire Street
PHILADELPHIA, Drexel Building
CHARLOTTE, N. C., Court House Square
PITTSBURGH, 604 Frick Building
DETROIT, 804 Ford Building
CHICAGO, 1539 First National Bank Building

# ROCK DRILLS

The footage drilled per day, per month or per year is the measure of rock drill capacity.

The total cost per foot of hole drilled, month after month, is the measure of rock drill economy.

The drill which shows the largest footage at the least total cost is the drill which is the best money-maker for its owner.

**The experience of the largest mines, quarries, and contracts, the world over, has proved that Ingersoll-Rand Rock Drills are the standards of capacity and efficiency, which stand for maximum profits.**

COMPRESSORS HAMMER DRILLS PLUG DRILLS

## Ingersoll-Rand Co.

NEW YORK LONDON

OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

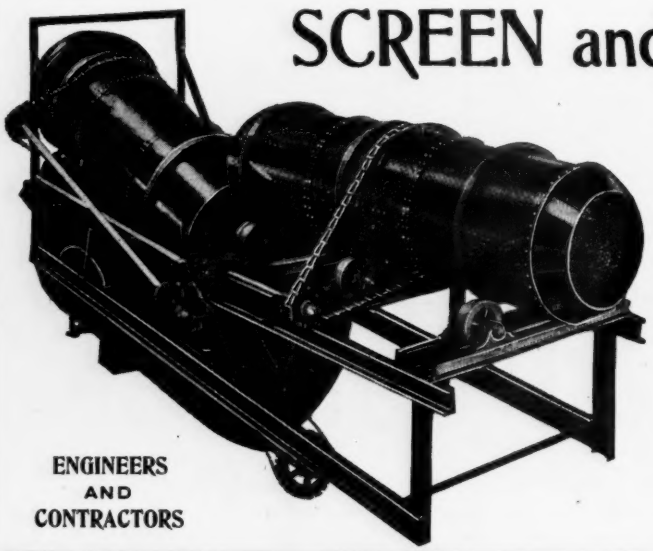
## INDEX TO ADVERTISERS.


Atlantic Refining Co. ..... 9
Black Diamond ..... 12
Boiler Maker .....
Borne, Scrymser Co. ..... 18
Brown & Seward ..... 15
Baldwin Locomotive Works, The ..... 11
Bury Compressor Co. ..... Back Cover
Cameron Steam Pump Works, A S. ..... 5
Chicago Pneumatic Tool Co ..... Back Cover
Continental Oil Co. ..... 9
Cooper Co., C. & G. ..... 6
Curtis & Co. Mfg Co. ..... 16
Dixon Crucible Co., Jos. ..... 10
Engineering Contracting. .....
Engineering Digest. .....
Engineering Magazine. .....
Engineering News. .....
Fiske Bros. Refining Co. ..... 2
Galigher Machinery Co. ..... 3
Gardner Governor Co. ..... 6
Goodrich Co , The B. F. ..... 2
Harris Air Pump Co ..... 12
Ingersoll-Rand Co. ..... 7 and Front Cover
Janney, Steinmetz & Co. ..... 14
Jarecki Mfg. Co. ..... 16
Jewett ..... 14
Latta Martin Pump Co. ..... 15
Lidgerwood Mfg. Co. ..... 4
McKiernan-Terry Drill Co. ..... 18
McNab & Harlin Mfg. Co. ..... 12
Mason Regulator Co. ..... 6
Metric Metal Works ..... 19
Mines & Minerals .....
Mining & Scientific Press .....
National Brake & Electric Co. ..... 13
Oldham & Son Co , Geo. ..... 17
Pangborn Company, Thomas W. ..... 18
Penberthy Injector Co. ..... 17
Porter Co., H. K. ..... 11
Powell Co., Wm. ..... 14
Proske, T. H. ..... 9
Quarry. .....
Republic Rubber Co. ..... 10
St. John , G. C. ..... 19
Standard Oil Co. ..... 9
Stearns-Roger Mfg. Co. ..... 8
Sullivan Machinery Co. ..... 4
Vacuum Oil Co. ..... 9
Westinghouse Air Brake Co ..... Back Cover



Clean-Washed Material Permits Accurate Sorting

The "CRANE" SCREEN and WASHER



ENGINEERS AND CONTRACTORS

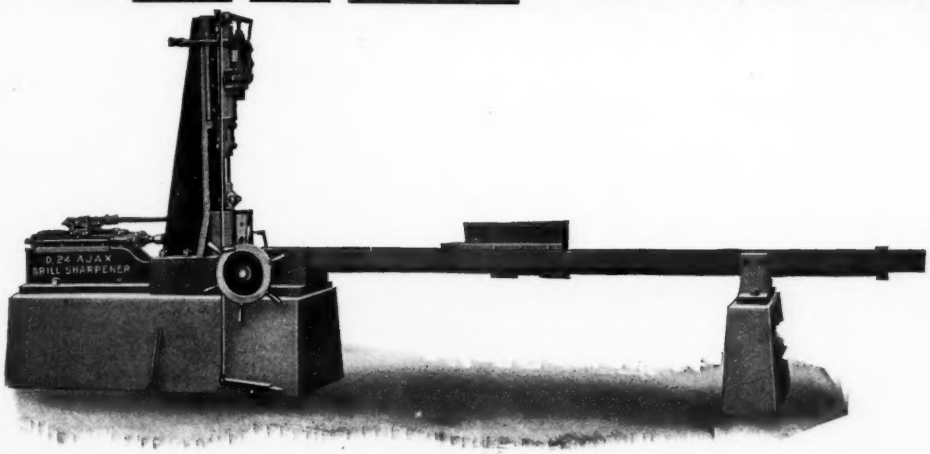
COLLECTS

Rich "Fines" by Screening
Rich "Slimes" by Washing
Rich "Lumps" by Picking

Complete Plants for Concentration, Cyaniding, Chlorination and Smelting of Ores.

Stearns-Roger Mfg. Co.
1718 California St.,
DENVER, - COLO.

## WHY ARE "AJAX" DRILL SHARPENERS SUPERIOR TO ALL OTHERS?




**BECAUSE—**

They use Ingersoll-Rand Drills for hammers, making it possible to secure duplicate parts of these most important features *anywhere.*

All parts are made much heavier than even the most severe stresses upon them require.

The dies and dolly are much larger, insuring long life and low cost of renewal.

**Mfg. by T. H. PROSKE,**
**Denver, Colo.**

**BECAUSE—**

They can be operated either as right or left-handed machines—an exclusive "Ajax" feature.

They use no power when not actually sharpening drills.

They will sharpen drills faster and better than any other known way.

They are more economical in operation and upkeep, and will outlast any other sharpener.

**Sold by INGERSOLL-RAND CO.**
**All over the world.**

## For Use on the Leading Makes of Air Compressors

ARGON COMPRESSOR OIL
For Air Cylinders of Electric-driven Compressors.

ARIO COMPRESSOR OIL
For Air Cylinders of Steam-driven Compressors.

VACUUM 600 W CYLINDER OIL
For Steam Cylinders of Compressors.

KEARSARGE ENGINE OIL
For Bearings of Compressors.

FOR SALE BY

**STANDARD OIL CO.**
**Incorporated.)**

**THE ATLANTIC REFINING CO.**
**(Incorporated.)**

**CONTINENTAL OIL CO.**
**(Incorporated.)**

VACUUM PALE COMPRESSOR OIL
For Air Cylinders of Steam-driven Compressors.

VACUUM 600 W CYLINDER OIL
For Steam Cylinders of Compressors.

VACUUM ETNA MACHINE OIL
For Bearings of Compressors.

FOR SALE BY

**VACUUM OIL COMPANY**
**(Incorporated.)**

# ROCK DRILLING

WITH PARTICULAR REFERENCE TO

**OPEN CUT EXCAVATION**

AND

**SUBMARINE ROCK REMOVAL**

BY

**RICHARD T. DANA**

AND

**W. L. SAUNDRRS**

The chief engineer of the Construction Service Company and the president of the greatest organization in the world manufacturing rock cutting machinery, have here collaborated in the production of a standard book of practical information derived from actual working conditions. Full of facts, figures, illustrations and data.

*319 pages, 6 x 9, illustrated.*
*Cloth,* **$4.00** *net* **(17s.)**

FOR SALE BY

**THE COMPRESSED AIR MAGAZINE CO.**
**11 Broadway, New York City**

# Dixon's Pipe Joint Compound

will be found better than red or white lead for the making up of all threaded connections.

Dixon's Compound is a lubricant rather than a cement and so not only assists in making tight joints, but permits of easy disconnection.

Booklet 188-D free on request.

**JOSEPH DIXON CRUCIBLE COMPANY**
**Jersey City, N. J.**

# The Republic Rubber Co.

**Manufacturers of**

*High Grade Hose*

*for Steam, Air Drill, Suction, Water, etc.*

*Rubber Belting and Valves*

**FACTORIES**

**YOUNGSTOWN, Ohio**

**BRANCHES**

**NEW YORK** **PITTSBURG**
**CHICAGO** **SAN FRANCISCO**

# COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XV NOVEMBER, 1911 No. 11

FIG. 1. GENERAL VIEW OF CHANNEL WORK IN THE HUDSON NEAR MECHANICVILLE.

## SPECIAL DEEP-HOLE DRILLS AND WORK ON THE BARGE CANAL

By Lucius I. Wightman.*

In these drills, called "autotraction drills," the drill truck or carriage consists of a heavy timber frame mounted on flanged steel wheels running on a track of wide gage. Chain-and-sprocket and gear drive between the forward truck wheels, and an independent reversing engine on the rear of the frame, provide for the movement of the machine along its track from hole to hole. Over the forward wheels is a turntable about 8 ft. in diameter, which is rotated by means of a hand crank operating a pinion and outside gear on the circumference of the turntable. Clamping screws lock the turntable in any position desired. Built up on the turntable is the drill mounting or frame, of steel angles and channels

*29 Broadway, N. Y. City.

rigidly braced. The base of this frame, made of two channel irons, extends forward beyond the turntable about 3 ft., and carries a heavy jack-screw which is run down to a block on the ground, giving rigidity to the drill rig when at work. The vertical members of the frame are channel irons which serve as guides for a heavy cast-iron block to which the drill proper is bolted; and this block is raised or lowered, with the drill, by means of steel cables passing over sheaves at the head of the frame to a drum below geared to a small reversing engine. In the particular drills here described, the weight, with the drill, has an up-and-down travel of about 16 ft. This travel or length of feed can be altered, when a machine is built, to suit the conditions under which it is to operate. In the present case it was necessary to provide only for holes 12 to 15 ft. deep.

The drill proper is a standard Ingersoll-Rand rock-drill, of "H-61" submarine type. Its cylinder diameter is 5½ ins., the stroke 8 ins. At 75 lbs. pressure it has a speed of about 250 blows per min. The machine has the standard features of "Sergeant" release rotation, cushion back-head spring, and U-bolt chuck. Air is supplied through a length of hose leading to a throttle valve placed within easy reach of the operator's hand, close to the lever controlling the feed engine. The drill and frame are so placed on the turntable that when the turntable is resolved the steel describes the arc of a circle 10 ft. in diameter, swinging to both sides of the machine.

A small water pipe about 15 ft. long, with a hose connection, is swung from a block-and-tackle at the head of the frame, and gradually fed downward into the hole, as the steel descends. In the Barge Canal work, water at 20 lbs. pressure is piped all over the ground, and the drill pipe takes its supply from these mains. But a small direct-acting pump is mounted on the truck, by means of which water can be drawn from any pool or other source at hand and forced through the water pipe into the hole. Compressed air for the drill and engines is taken from air mains, laid over the work.

The work on which these drills are engaged is in Sections 68 to 72 of the New York State Barge Canal, on the Champlain Branch, running northward in the Hudson Valley from Troy through Waterford, Mechanicville and Stillwater. The contract at Waterford is in the hands of the Merion Construction Co. The Shanley-Morrissey Co., Inc., is the contractor for the divisions at Mechanicville and Stillwater. The canal construction in these sections consists in the deepening of a portion of the Hudson River channel to form a waterway for barge traffic 200 ft. wide and 12 ft. deep in the clear.

In the greater part of these sections, excavation has been carried on by a method calling for the construction of cofferdams shutting off portions of the river channel, the space within being pumped out by centrifugal pumps. These portions vary from a quarter of a mile up to a mile in length, and in many cases the cofferdams extend from the shore to islands in mid-channel. The exposed river bed is removed to the proper depth and width by drilling and blasting, loading the muck by steam shovel, and hauling away the waste in dump-car trains by steam locomotives. In some places this method could not be applied, and the river bed has been drilled and blasted and dredged on to barges, by means of a combined submarine drill scow and dipper dredge. The completed work will afford a clear channel paralleling the river, adapted to the heavy-draft vessels contemplated for the Barge Canal service. At Stillwater a tying-up basin or harbor is being excavated between two islands, beside the canal channel.

The rock encountered in these sections is a black Hudson shale, hard and brittle in its bed but crumbling under the atmospheric action when exposed. It lies at an acute angle so that the river bottom, when exposed, presents a jagged, hummocky appearance with a surface so rough and irregular as to make transportation of any kind over it impossible without laying track or building roadways.

At the time of the writer's visit to the work, drilling operations were temporarily suspended on all sections except one at Stillwater. Between Mechanicville and Waterford, the bursting of a cofferdam had flooded the bed and forced the removal of all drills and steam shovels, while the dam was being repaired and the water pumped out. At Stillwater, below one of the completed locks, there were in operation two of the auto-

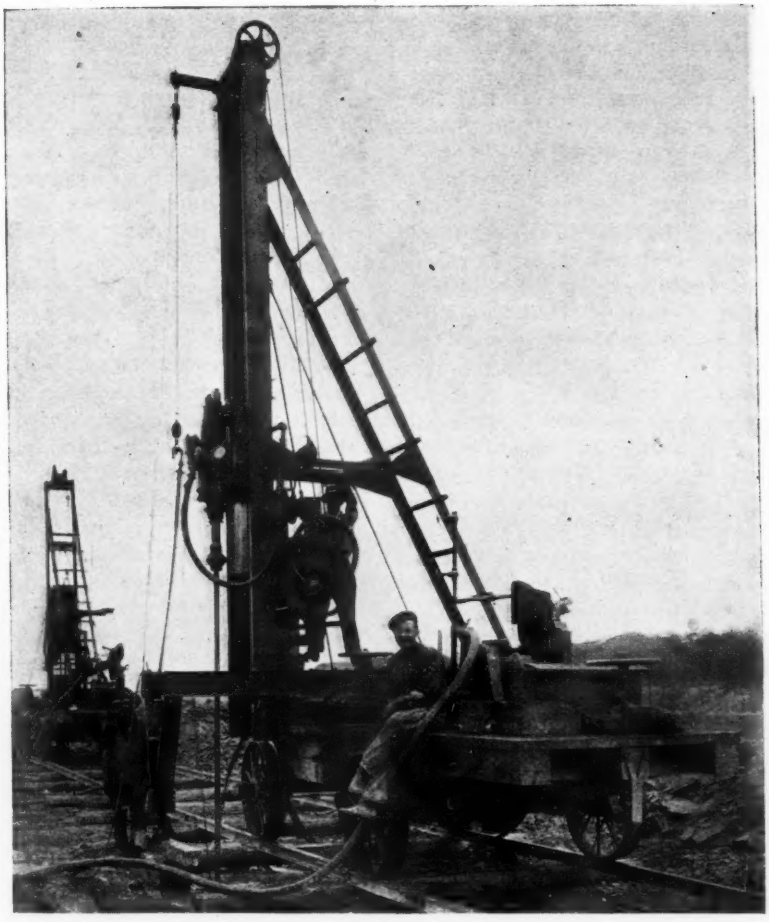


FIG. 2. TWO AUTOTRACTION DRILLS AT WORK.

traction drills, two steam shovels, and one well drill. At this point the autotraction drills were working on the bench about 100 yds. ahead of the shovel. They were running on a single track, one about 50 ft. ahead of the other. The working gang consisted of a drill runner and two helpers for each machine, with two or three extra men for laying track ahead.

The method of operation may be briefly defined as follows: The turntable of each drill is swung with the drill frame at right angles to the track; the jack-screw is set and a hole is drilled. The steel is withdrawn, the turntable swung until the frame is parallel to the track and another hole drilled midway between the rails. The turntable is then swung to the opposite side and the third hole drilled. Thus three holes are put down from each position of the machine, two on a line at right angles to the track, 10 ft. apart, and one 5 ft. in advance of the others and on a line midway between them. The drill is then moved forward on its track 5 ft., bringing the center of the turntable over the last hole between the rails, and three more holes are drilled in the same arrangement. When the following drill has caught up with the first holes of the leading drill, both are moved forward 50 ft. and started anew. This gives a triple row of holes 5 ft. on centers each way. When the

needed length has been covered, drills and track are moved and another triple row of holes paralleling the first is put down. The steel used is solid, 2 ins. in diameter, 15 ft. long, terminating in a 4-in. cross bit. It makes a 4-in. hole 12 to 15 ft. deep as required. The water jet in the hole flushes out the cuttings and gives the bit a clear face to work upon.

One hole was timed and was put in 15 ft. deep in 12 min. The drill-runner stated that his regular performance with his machine was from 160 to 200 ft. of 4-in. hole per 8-hr. shift. The best record on the work, under test conditions, was 165 ft. of 4-in. hole drilled in 4 hrs.

In operation, the drill-runner stands on the turntable, with the throttle valve and feed engine lever before him. The hole is started on short stroke in the usual way. The runner watches the drills and feeds the weight, with its drill, downward just enough to give full stroke without striking the heads. The weight of the cast-iron block absorbs the recoil of the drill. One man tends the water jet, lowering the pipe with the steel. The third man keeps the mouth of the hole clear, watches the jack-screws, and otherwise assists. As soon as a hole is finished, a wood plug is dropped in to keep it clear until ready for loading.

It will be observed that the 15-ft. hole is put down without change of steel, and three holes are drilled from a set-up. The number of holes which can be drilled with a steel varies with the tempering the smith has put in the bit. A poor bit may last only one hole. Well tempered steels will put in seven or eight holes. The average was three or four holes drilled per steel. The trouble is less in the dulling of the steel than in its loss of gage, so that later holes are of smaller diameter. This emphasizes the importance of careful attention to the smith shop when rapid, economical drilling is sought.

The view of Fig. 2 shows standard tripod drills working near the autotraction drills. A large number of these are employed on portions of the work. They are of the "Sergeant F-24" type, with 3½-in. cylinders, and in the illustration are putting down 15-ft. holes. But they suffer under the handicap of steel-changing and loss of time in moving, which limits the tripod drill; and it has been found that one autotraction drill does the same work per day as seven of the tripod drills. A well drill machine working nearby was averaging 80 to 85 ft. of 4-in. hole per day. It was the only machine of the type on the work.

While the performance of the autotraction drills has been eminently satisfactory, it is believed that better results still we be secured by the adoption of the Locher pump drill-steel.

Mr. C. H. Locher, of Thorice, Michigan, who invented this steel, is also the pioneer in the development of the deep-hole drilling machine of the general type here described. On the work of the contracting firm of Grant, Smith & Co. & Locher on the Livingston Channel of the Detroit River, he devised an autotraction drill capable of putting down a 5-in. hole 50 ft. deep at a rate far better than any realized up to that time.* This machine was of course experimental and somewhat crude, requiring changes of steel every 8 ft., but it contained the proper idea, and Mr. Locher has developed it through successive models to now show remarkable speed and efficiency. The inventor's later work was carried on in connection with the Ingersoll-Rand Co., and the perfected auto-drills just described were produced under collaboration of Mr. Locher and the company's engineers, the inventor having licensed the company under his patents.

The Shanley-Morrissey Co. has eight of these autotraction drills on their work at Mechanicville and Stillwater, and four additional machines are on order. The Merion Construction Co., at Waterford, use one autotraction drill.

It is to be understood that the machines here described were specially designed and built for these local conditions. These drills can be made for all classes of work. The depth and diameter of hole, character of rock to be drilled, spacing of holes, etc., all have vital bearing upon some features of construction. They may carry an air reheater, or be fitted with a steam boiler where necessary. The general design and method of operation, however, are as here described, in all the autotraction drills built by the Ingersoll-

*See a description by Frank Richards in Compressed Air Magazine, Jan., 1910.

Rand Co. Patents are either issued or pending on the essential features of these machines, in favor of that company. Several deep-hole autotraction drills of this general type have been built for Mr. Locher's own work, and are in operation at Gross Isle. Others are on order for use on some sections of the Catskill Aqueduct of the New York Water Supply, and on the Barge Canal.

## MINE VENTILATION ON THE RAND

By Frederick H. Hatch.

In the early days of the Rand, and, indeed, up to quite recently, it was not found necessary to employ any artificial system of ventilation, the numerous shafts and outlets to the surface of the outcrop mines having sufficed to maintain an ample supply of fresh air. But with deeper levels (the Village Deep mine is already working at a vertical depth of 4,000 ft.), fewer communications with the surface, and an increased rock temperature, artificial ventilation is destined to play an increasingly important part. Stuart Martin gives it as his opinion that it will be impossible to work the deep levels economically without carefully thought-out schemes of ventilation; and that for the success of these, it will be necessary to have shafts with small frictional resistance and large air space, and to carry the air current through special ventilating roads.

The quantity of pure air to be supplied per minute, per man employed underground is fixed by law at 70 cu. ft. This being a standard difficult to enforce, the South African Mining Regulations Commission, whose report was pubilshed in 1910, prosposes as a substitue, the quality standard, based on a maximum of 20 parts by volume of carbon dioxide per 10,000 parts of air. Of this, four parts is an allowance for the $CO_2$ normally present in the atmosphere; three parts are allowed for the $CO_2$ produced by the burning of candles, and there is a further allowance of five parts for the $CO_2$ possibly given off from the country rock, leaving eight parts per 10,000 as a legal limit for the noxious $CO_2$ due to the vitiation of the air by blasting, human emanations, etc. Under the proposed regulations provision is to be made at each mine for a permanently up-cast and a permanently downcast shaft, by the use of ventilating fans, or otherwise; and the current of fresh air so produced is to be split by regulating doors at every level where work is carried on, in proportion to its requirements. Further, the courses of pure supply and foul return are to be kept distinct by bratticing, and short circuiting is to be prevented by stopping disused drives, stopes, etc.

The ventilation problem has already been seriously attacked on the Rand, and already ventilating fans, varying in capacity from 50,000 cu. ft. per min., at 1-in. water gage, to 250,000 cu. ft., at 4-in. water gage, have been installed at the East Rand Proprietary mines, at the Simmer Deep, at the Village Deep, at the Langlaagte Royal Shaft of the Crown mines, and at several other mines of the Eckstein Rand mines group. In splitting the air current the numerous dikes of igneous rock that traverse the Witwatersrand mines in a north and south direction (i. e., across the strike) can be made to serve as natural brattices, since they cut up the mines into air-tight compartments. The levels that penetrate these dikes must be permanently closed, or, if used for tramming, closed by double swinging doors.

The ventilation of the mines is hampered by the small air space and large frictional resistance of the rectangular timbered shafts at present in use on the Rand. For this reason many of the deeper shafts of the future will, no doubt, be of the circular type, with either brick or concrete lining, as is the common practice in the collieries of South Africa. Already a large circular shaft is being sunk at the New Modderfontein mine.

Main levels and underground inclined shafts will also be driven in the foot wall. These will serve as intakes for the air current, and, being in solid ground, will reduce the loss of air by short-circuiting to a minimum. Since these main ventilating roads, instead of following the regular course of the reef plane, are driven straight, they will be admirably adapted for cheap mechanical transport.

---

When the foundations of a New York skyscraper are completed and the erecting of the steel skeleton is about to begin the fact is indicated by a change in the color of the derricks. At the Woolworth building, which is to make a new record for height, the derricks have changed from green to orange.

## BOTTOM HEADING DRIVING ON THE HUNTER BROOK TUNNEL

By Arnold Becker, E. M.*

Because of the very notable success achieved by the builders of the Loetschberg tunnel, in Switzerland, much has been written of late concerning the methods used by them. Mr. W. L. Saunders and Mr. Eugene Lauchli, particularly, have contributed valuable and highly instructive papers on this subject, and they have been ably answered by advocates of the more ordinary tunnel method. The discussion has lacked a certain definiteness, however, because the comparison has been between Swiss and American tunnels, driven by the new and the old methods respectively, and in countries where the costs of labor, material, power and all things that go to make up the grand total of costs in such enterprises differ so widely that an intelligent comparison is difficult.

It is my purpose herein to give facts and figures concerning the Hunter Brook tunnel of the Catskill Aqueduct, now being completed for the city of New York by the Glyndon Contracting Company, at Yorktown Heights, N. Y. This tunnel is 6150 ft. long, 276 sq. ft. (minimum) cross-section and has, except for the first few hundred feet, been driven by a method that is similar in the chief essentials to that used in the Swiss tunnels. As all records of cost have been most exactly tabulated for seven months past, it is possible to show definitely the economies of the method in this country and to state the reasons therefor. The change in method has resulted in a reduction of labor cost from $6.63 to $2.55 per cubic yard, and an increase of average progress from 126.5 ft. to 270.5 ft. of completed tunnel per month. This rock is mica schist and hard, close grained gneiss. The faulting is complicated and in places the ground is very treacherous and difficult to drive through, as described in an earlier issue of the *Engineering Record*.

### THE MINING METHOD OF TUNNELING.

As a preliminary, it should be pertinent to point out the reason for the wide differences of opinion as to this so-called Alpine method, which is really a mining method. It is a curious thing that such great underground works as railway tunnels, whole series of aqueduct tunnels and subway systems costing scores of millions should have been built by various adaptations of surface methods which have been uneconomical and usually very slow; while mining methods, the results of many centuries of evolution toward the truest economy in underground excavation, have been ignored except in the most recent Swiss tunnels and in two aqueduct tunnels in this country (Hunter Brook and Elizabeth Lake) now under construction. Undoubtedly the reason is that such works have usually been parts of larger surface systems that have fallen to the lot of surface men to build. The result is that there are two absolutely opposed methods of underground excavation; the one directly evolved from surface methods and almost universally used for large tunnels and subways, which is unnecessarily costly; the other a purely underground method, developed in the metal mines through many generations of labor-saving and cost-saving effort.

The essential difference lies in the use or neglect of gravitation as a force. The surface man habitually excavates from the top downward. This is the natural and proper thing to do in outdoor work. The American tunnel man has taken this inherited principle underground, wherefore he excavates his top heading first and then digs down to grade (Fig. 1). All of the excavated material must, by this method, be shoveled into cars, which is a misuse of the force of gravitation, in that this force is made to work against the operation instead of for it.

The miner, whose business it is to excavate ore bodies which almost always exceed in depth and very often exceed in width and length the greatest tunnel ever driven, always gets below the ore to be excavated with the smallest workings possible, ordinarily a shaft and a series of levels that are 100 ft. or more apart, and then excavates or stopes upward, from level to level, dropping the ore through loading pockets and chutes into cars for transport to the surface. The stopes usually represent over 90 per cent. of the total excavation in a successful mine and shovels are unknown in them unless the vein be too flat for the ore to run. The greatest item of labor, the actual handling of the ore, is thus avoided by a proper use of the force of gravitation.

A miner, when called upon to drive a tun-

*President Glyndon Contracting Company.

nel of large cross-section, instinctively drives a bottom heading on grade and, by the use of simple devices, stopes out the top, handling the excavated material into cars by gravity By application of this and other mining methods it is not only possible to handle over 50 per cent .of the excavated material at minimum cost but to increase speed far beyond anything that has been accomplished by the ordinary method. In the case of subways the application of well-tried principles of lode mining should be even more important, not only for the economy in actual excavation but because, in very many cases, all tearing up and relaying of streets, interfering with traffic, disturbance of water and gas mains and endangering of foundations could be avoided and the great expense of these factors in the ordinary method of subway building saved, without sacrifice of speed or economy of construction. Subway building by the open-cut method involves, in the initial stages, destruction of valuable property which must be replaced. This is seemingly unavoidable where the proposed subway is so close to a street surface that mains and conduits (other than sewers) occupy any part of the space actually required for the subway, its walls and roof; but, with this exception, the work could be done by mining methods, and a' serious economic waste avoided.

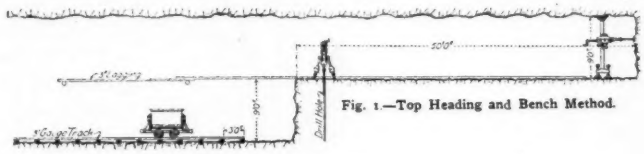


Fig. 1.—Top Heading and Bench Method.

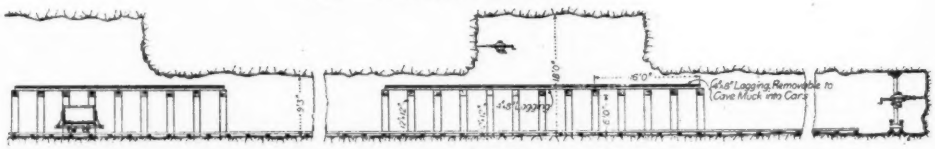


Fig. 2.—Bottom Heading and Stope Method, Showing Multiplication of Stopes.

BEGAN IN THE OLD WAY.

The Hunter Brook tunnel was started at the north portal on October 6, 1909, and at the south portal on December 15, of the same year. The top heading and bench method (Fig. 1) was used with heavy loss. I was called in consultation late in May, 1910, and a few days later was retained as chief engineer and manager. At that time the north tunnel had been driven 677 ft. and the south tunnel 716 ft., the average progress having been 84 ft. and 126.5 ft. a month respectively.

Th problem was to complete the tunnel within the contract price and without adding more in the way of equipment than could be helped. Economy rather than speed was the requirement. Also, there were 5295 lin. ft. of outside concrete conduit to be built, requiring 25,000 cu. yd. of crushed rock, the only source of supply for which was the south tunnel, and months of preparatory work were needed before this outside conduit could be started. It was apparent that if the south tunnel were completed ahead of the outside conduit we should have to rehandle our concrete rock at considerable expense. Therefore the tunnels were run with two 8-hour drilling shifts only and three small mucking shifts; and for the same reason the north tunnel was closed down on April 15 last, 1956 ft. from the portal. The south tunnel will hole through in October, 1911.

The first method tried was to drive a bottom heading on grade 8 ft. wide and 9 ft. high; then to stope in the top and finally the sides. This permitted only one link of track in the heading, as all cars were 36-in. gauge. As we had to rely on mule haulage we were unable to take away the muck fast enough on one track. It became necessary to use two tracks and consequently to widen the heading, which was, thereafter, driven full width, 15 ft., a procedure which was unavoidable in this case, but which would not be advisable where proper equipment and electric haulage for a small heading could be provided.

BOTTOM HEADING.

The bottom heading (Fig. 2) is driven on

grade, with four Ingersoll-Rand 3.5-in. drills mounted on two columns. The round varies from 16 to 28 holes, according to the rock. Cut holes and lifters are driven between 6 and 7 ft., and breakers 5 ft. Steel slick-sheets are laid from the breast for at least 20 ft. back before blasting. The round is shot with 60 per cent. forcite and invariably with fuses and caps, in rotation. By this method the holes almost always break to bottom, which they do not do with battery shooting.

Immediately, after the blast four picked muckers muck back the heading They work a split shift and are paid from $2.50 to $3.00 per day. They get a bonus for quick work and go home as soon as the heading is cleared for the drill columns. They usually do this in three hours, making their actual working day six hours. With the heading cleared twice a day, in this way, the drill shifts easily set up, drill and shoot their rounds within the eight hours allowed each of them. The regular mucking gangs, shoveling off slick-sheets, usually finish ahead of time and then lay track and extend pipes for the next shift.

The powder consumed averages 7.5 lb. per cubic yard in the bottom heading. The rock is very tough, but, owing to the method of shooting and the quantity of powder used, is broken fine enough to be easily shoveled—though the same rock, when broken from a bench, is so blocky as to require handling by power into cars. An effort was made to cut down the quantity of powder used, but this soon proved to be a false economy. The muck broke larger and more labor was required to handle it.

The regular heading drilling shifts are each made up of

| | |
|---|---|
| 1 shift boss, at | $5.00 |
| 4 drill runners, at | 3.50 |
| 4 helpers, at | 2.25 |
| 1 nipper, at | 2.00 |

The regular mucking shifts are each made up of

| | |
|---|---|
| 1 muck boss, at | $3.50 |
| 8 muckers, at | 2.00 |

The five months from March 15 to August 15, 1911, afford representative figures; the tunnel was shut down during the winter and the force was not fully reorganized until early in March. During these five months there were excavated from the bottom heading of the south Hunter Brook tunnel 6916.685 cu. yd. at a total labor cost, including blacksmithing, but not including haulage, of $23,476.86, or $3.40 per yard. From July 15 to August 15, 1911, bottom heading progress was 289 ft., at a total labor cost of $3.29 per cubic yard. Overhead charges, power and haulage are not included in the above, as these items vary with each locality. The salaries of the tunnel superintendent and the night superintendent are carried in overhead.

TOP HEADING OR STOPE.

A timber gang, consisting of a foreman, two timbermen and two helpers, working on day shift only, puts up the temporary sets required for the stope (Fig. 3). These are of 10x12-in. posts with 12-in. round caps, placed at 3-ft. centers and heavily lagged over the top. A gap of 30 in. in the first layer of lagging is left continuously above each track, and this is covered by short cross-lagging, which can be removed, piece by piece, with a pinch bar, whereby the stope muck pile is caved progressively into cars.

The top of the temporary platform, so provided, is 7.5 ft. above the tunnel floor. The bottom heading having been driven 9.25 ft. high, there is left a free space of 21 in. above the temporary timbering to break to. This space is necessary for the success of the operation. Without it the timbers would be broken by blasts above, and the only alternative would be to adopt the underhand stoping method of the Simplon and Loetschberg tunnels, which is more costly. No timbers have been broken in the Hunter Brook tunnel since round caps were substituted for square ones last winter.

In the stope two Ingersoll-Rand 2.5-in. drills are used on an 8-ft. cross bar (Fig. 4). The round varies from 12 to 16 holes, which are all breakers. These are shot with fuse entirely, the bottom holes being shot first, lightly, then the next row above, and so to the top. The timber caps are supported by extra temporary posts during shooting (Fig. 4), and the muck is all held on the timber platform. It is then rapidly caved into cars, through the lagging, as above described, by two men. Battery shooting would be impossible in the

stope. It would break the timbers, inevitably.

This operation leaves the stope incomplete, as shown in Fig. 4. One drill runner, using an Ingersoll-Rand telescope feed stoping drill, which is the fastest tool yet devised for upholes, follows and drills trimming holes to a line given him by the survey crew. These are shot with the next regular round. The same man drills and shoots any trimming holes that may be necessary to perfect the lower half of the tunnel, as indicated by the surveyor.

The bottom heading and stope are checked, as to line and grade, each day by the company's surveyor and no trimming is left undone. The temporary sets and lagging are regularly moved forward from behind the stope, to be reused. Such pieces as are injured are used up for blocking.

In order to facilitate the work of stoping, it has been found expedient at times to separate the drilling, mucking and trimming operations in the top. This is completely accomplished by putting up a raise about every 300 ft., as shown in Fig. 2. By this system three stopes are always in operation. Drilling is going on in one, mucking in another and trimming in the third. This avoids any interference by the various gangs with each other's work and greatly facilitates progress. All the equipment used in stoping is light and can readily be moved. The chief advantage is that the drill runners always have a clean breast to work at, with no muck to hinder them. The top crew consists of:

| | |
|---|---|
| 2 drill runners, at | $3.50 |
| 2 helpers, at | 2.25 |
| 2 muckers, at | 2.00 |
| 2 car handers, at | 2.00 |

From March 15 to August 15, 1911, there was stoped from the top of the south Hunter Brook tunnel a yardage almost exactly equal to that of the bottom heading, but at a labor cost, including blacksmithing and all cost of temporary timber platform and maintenance thereof, of $1.69 per cubic yard, making the average labor cost per yard for the completed tunnel $2.545 in the cars. The powder consumption in the stopes, for the same period, was 2.5 lb. per cubic yard.

When the ground requires timbering a regular timber crew follows closely after the trimmer, placing permanent sets. If the ground is very treacherous, the permanent timbering can be kept within 3 ft. of the stope breast without danger of shooting out the timbers, since all holes in the stope break downward and do not require heavy charges. No cut holes are ever needed or used in the stope. Where permanent timbering is required it is always best to run three or more stopes.

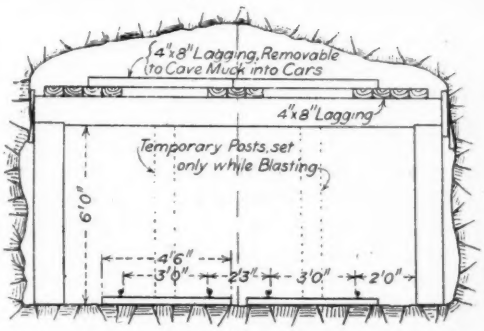



**Fig. 3.—Bottom Heading and Temporary Timber Platform.**

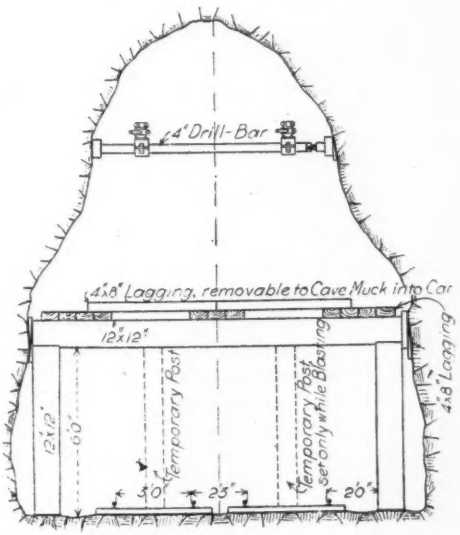



**Fig. 4.—Method of Stoping Out the Top.**

ECONOMY AND ELASTICITY.

The advantages of this method are several. The most important is that 50 per cent. of the muck is handled from the stopes directly into cars, by gravity, at a minimum of labor and cost. By the old method all of the muck in the top heading is shoveled into wheelbarrows and wheeled the whole length

of the bench and beyond, to be dumped into cars. This requires a large crew of muckers and wheelbarrow men for the top heading, besides an equally large crew to muck the bench.

Timbering is a much more simple process by the mining method. It can be kept close to the breast without injury to timbers and wall plates are unnecessary, each set being built up from grade; neither need there be any delay. By the old method wall plates must be placed first, which is a slow operation; then the arches are placed and later, when the bench has been blasted out at considerable risk to the upper timbering, posts are set under the wall plates. Very frequently timbers are blown out by the heavy blasts of the cut in the top heading; and I have known six or eight such sets to be brought down by an unlucky round in the bench. All of this is avoided by the mining method.

Finally, there is more elasticity. The greatest effort for progress is concentrated in the bottom heading, to which everything else gives way; for here there is only one point of attack possible. If for any reason the top falls behind, it does not greatly matter. Progress of the bottom is not thereby impeded and the top may be attacked from as many new raises as may be required to make up lost time, whenever it is convenient to do so. By the old method, however, if the bench falls behind, work in the top heading is immediately made more difficult and costly.

Tunnel driving is an industry wherein speed and economy are equivalent terms, unless because of some outside and conflicting factor. In most lines of endeavor it is possible to spread out, to divide the work into sections, particularly in railways, canals and similar surface undertakings, which can be attacked at many points simultaneously. In deep tunnels, however, the space is confined, the number of men that can be advantageously worked is strictly limited and the points of initial attack are never more than two, unless shafts be put down to provide more headings. As shafts involve hoisting and usually pumping, they are to be avoided unless in long tunnels, the early completion of which may justify considerable extra cost.

Manifestly, then, speed in the heading should be the first consideration. The number of men being limited by the working space the crew is constant in a heading of given size and the cost per foot may be said to vary in inverse ratio to the speed.

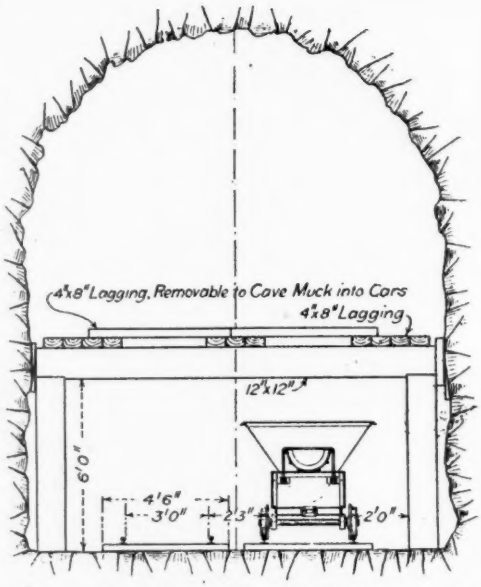



**Fig. 5.—Completed Tunnel, Timbers to be Moved Forward.**

It is also manifest that the heading is the most expensive part of tunnel excavation. Since the rock is exposed on one side only, it must be torn out. All other rock to be removed, after the heading has passed, is exposed on at least two sides and may be broken inward to a free space with fewer drill holes and less explosive. It follows that the heading should be as small as may be practicable, and that transportation facilities should be fully adequate for removal of all the rock to be excavated from bottom heading, top and sides at the speed required. This means good track, electric haulage, plenty of quick dumping cars of narrow width, empties delivered as rapidly as needed at the heading and hauled away as soon as loaded, no interference with main line traffic by top and side excavation, and proper terminal arrangements outside.

If the traffic facilities be inadequate for removal of all excavated rock at the required speed on a single track, then the heading must be widened to permit double track. The heading yardage is thereby nearly doubled, the expense is increased and the speed of the heading and, of course, of the whole tunnel

is reduced. Money loss is in two directions: The proportion of most expensive excavation is materially increased and the period of overhead cost is as materially lengthened, whereby the cost of the excavation per unit increases proportionally.

An interesting comparison, showing the marked difference of results by different heading methods, is that of the Bergen Hill (Pennsylvania R. R.) Hunter Brook and Simplon headings.

| Tunnel. | Head. | Size. Sq.Ft. | Crews | Best Month, Lin.Ft. | Equivalent. Yardage |
|---|---|---|---|---|---|
| Bergen Hill* | top | 210 | 2 10-hr. shifts | 145 | 1127.77 |
| Hunter Brook. | bot | 138 | 2 8-hr. shifts | 289 | 1477.11 |
| Simplon† | ...bot. | 60 | 3 8-hr. shifts | 685.5 | 1523.33 |

*F. Lavis, *Trans.* Am. Soc. C. E., Feb., 1910.

†W. L. Saunders, *Trans.* Am. Inst. M. E., Feb., 1909.

The comparison shows quite clearly that speed increases in inverse ratio to the size of the heading.

Provided that equipment be suitable, there can hardly be serious question as to the advantages of the small bottom heading. Moreover, the Ingersoll-Rand drill carriage can be used in a narrow, single-track heading, but not in a wide heading with double track. The use of this carriage and all details of the Swiss bottom heading method seem admirable and highly practical. If one were inclined to criticize at all, it would be the Swiss method of stoping the top, which seems unnecessarily complicated, first, because small drifts are run from the top of each raise, after which the rock below is taken out by underhand stoping, which costs more than overhand stoping and has long been obsolete in American mining practice; second, because work in the stopes seems to be divided into more separate operations than would be resorted to in this country. Such details are overshadowed, however, by the wonderful heading records made in Switzerland.

Those records could, without any reasonable doubt, he duplicated in this country if the proper method were adopted and suitable equipment provided. The saving, in money alone, would be tremendous. The saving in time, especially where long tunnels are to be driven, would often be of paramount importance.

The mining method of tunneling requires very perfect organization, for more operations are going on at the same time than in an ordinary heading and bench tunnel. It is necessary to divide the work very closely and to train each man to proficiency in the particular work he has to do. The degree of organization will generally show in comparisons of monthly costs and progress. The record of the Hunter Brook tunnel, for the five fiscal months previous to this writing, is as follows:

| | Progress, Completed. Tunnel. | Labor Cost. Ex. Haulage. |
|---|---|---|
| March 15, April 15... | 278.5 ft. | $7096.39 |
| April 15, May 15.....* | 263.5 " | 6851.01 |
| May 15, Jun 15..... | 278.5 " | 7304.01 |
| June 15, July 15.....† | 259 " | 6676.65 |
| July 15, Aug. 15..... | 283 " | 7183.63 |
| July 15, Aug 15, head. | 289 " | |

*Easter holidays, April 16 and 17.

†Two holidays, July 4 and 5.

For the successful driving of this tunnel by a method which was entirely new in this part of the world much credit is due to Mr. Harry A. Leeuw, general superintendent of the entire work; to Mr. Peter Bachels, tunnel superintendent, and to Mr. Joseph Goodman, night superintendent.—*Engineering Record.*

---

### THE AIR PUMP VALVE FROZE

I once had occasion to use a double-acting pump for mine purposes, using air at 90 lbs. gage pressure. But I was continually bothered with the valves freezing, which stopped the pump.

Then it was the old story of burning a piece of oily waste to thaw them out and get the pump started again. This method, however, has often caused cracked and broken pumps, due to the unequal expansion.

I finally tried the scheme of tapping a ⅜-inch connection on the discharge pipe, near the pump, and leading the same around and over the air chest, branching off over each chest. Then I put in a ¼-inch pet cock about 4 inches above each chest so as to get a small stream of warm mine water to flow over the top of each valve chest while the pump was working. This ended the trouble.—W. Cooke, Chignecto, N. S., in *Power.*

## EXPANSION VALVE GEAR FOR STEAM OR AIR-HAMMERS

Fig. 7., here reproduced from *The Engineer,* London, shows a hammer designed to be operated with either steam or air—the latter being employed with increasing frequency—and provided with an improved valve and valve gear, enabling the operating fluid to be used expansively. The object of the makers, Messrs. B. and S. Massey, Openshaw, England, in designing this gear has been to reduce the consumption of the working fluid without the introduction of complicated mechanism, and without sacrificing ease of manipulation. Figs. 1 to 6 show sectional views of a hammer of the arch form, the piston valve being in section in four different positions. Fig. 7 represents a steam hammer of the Rigby type to which the mechanism has been applied.

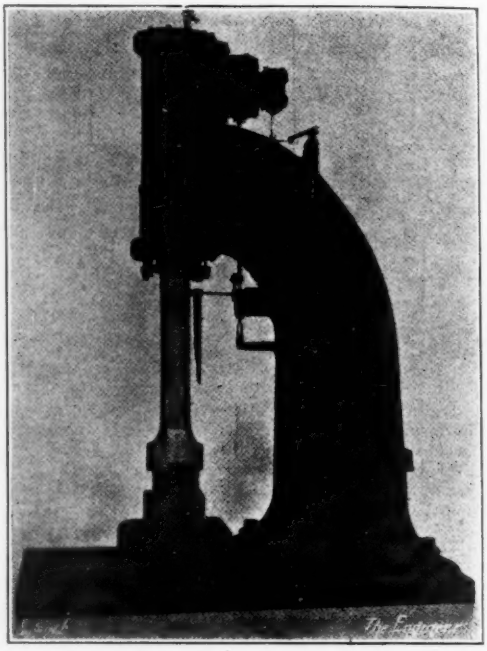
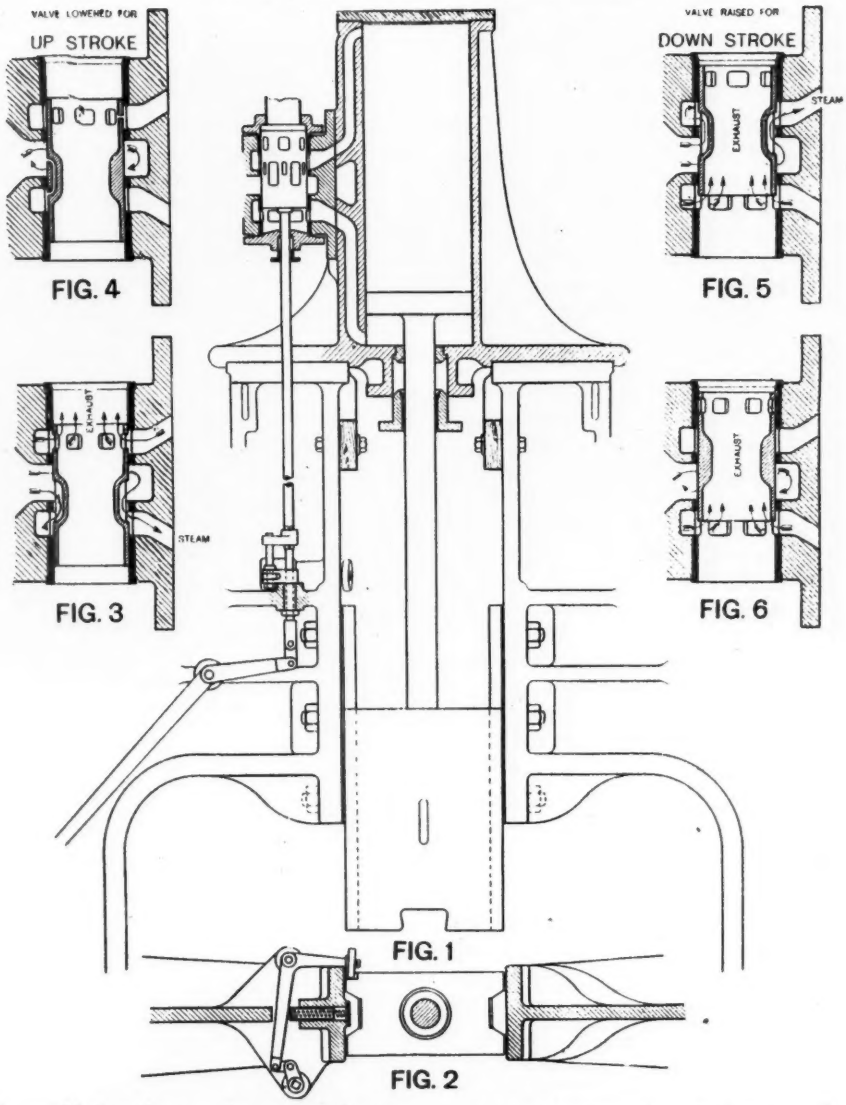


FIG. 7. HAMMER WITH EXPANSION VALVES

The chief feature of the gear is that the hand worked movement and the automatic cut-off are entirely separate and in different directions. The hand movement of the piston valve for the ordinary control of the hammer is vertical, whereas the automatic cut-off movement is rotary, the valve being turned through a small arc of a circle by levers and tripper mechanism actuated by the tup. Referring to the sectional illustrations it will be observed that when the valve is in the position shown in Fig. 3 steam is admitted to the under side of the piston, and simultaneously the space on the top side of the piston is opened to the exhaust. The result is an upward movement of the working piston, and in rising the tup comes in contact with the tripper, clearly shown in Fig. 1, and rotates the valve by means of the roller mechanism, cutting off the steam below the piston and closing the exhaust above—Fig. 4. During the remainder of the stroke the steam below the piston is used expansively, and the compression of the entrapped steam above the piston produces a cushioning effect which brings the hammer quietly to rest and prevents the possibility of blowing off the cylinder cover which is liable to accompany the operation of steam hammers by inexperienced persons. Although the valve mechanism is thus arranged to cut off the supply of live steam at a certain position of the stroke, the valve is so designed that when the hammer is at the top of its stroke a small port is uncovered which admits just sufficient steam below the piston to keep it suspended for "holding up" purposes.

On moving the valve into the position shown in Fig. 5 the bottom of the cylinder is opened to exhaust and steam is admitted above the piston for forcing the hammer down. As the tup descends the valve is rotated back again until at a predetermined point in the stroke steam is entirely cut off—as shown in Fig. 6—and the steam is therefore used expansively during the remainder of the stroke. For "holding down" supplementary ports are provided which come into operation when the hand lever is placed a little below mid position. These ports also serve to produce short strokes, but are closed when a longer travel is given to the valve for ordinary working.

The makers claim that the expansion gear gives a considerable economy of steam consumption compared with ordinary valve gears, as the steam is used expansively on both strokes. They also claim that "after flow"—the useless and wasteful flow of steam into the cylinder after the blow has been struck—is prevented; that clearance loss is




largely avoided owing to the automatic compression at the end of the up stroke; and that direct leakage of steam past the valve when the hammer is holding up is prevented. During the latter operation the valve is arranged to occupy the position in which the lap is at its maximum. With regard to the control, this we found most simple, enabling an unskilled person to use the hammer without danger. Owing to the operation of the tripper and roller mechanism on the valve no shock to the attendant's hand is possible, and a further advantage is that the hammer can be held up at the extreme top of the stroke.

Air under pressure, whether at 2 lb. or 150 lb., has come to be regarded not as an elusive, intangible quantity, but as a commercial commodity, the handling of which requires judgment. This is a subject to which a great deal of attention is being devoted at the present time, attention that has lately been reflected in the purchase or planning of equipment. Similarly, apparatus that is pneumatically operated finds increasing application, and is bought more than formerly on the basis of demonstrated efficiency.—*Iron Age.*

## TYPES OF MINE-RESCUE BREATHING APPARATUS

By James W. Paul.*

The types of breathing apparatus used by the Bureau of Mines carry a supply of manufactured oxygen. The purpose of these types of breathing apparatus is to supply the wearer with oxygen, and to absorb the carbon dioxide and the moisture exhaled in his breath. To accomplish this purpose, the apparatus are so made as to permit the wearer to use the oxygen that is exhaled in his breath, and to permit him to breathe over and over again the nitrogen that is in his lungs and any that is inside the apparatus.

### TYPES OF BREATHING APPARATUS.

There are a number of types of breathing apparatus. Those in extensive use are of European make, and several of them, including the Draeger, the Westphalia and the Fleuss, which have been tested and used at the mining experiment station of the Bureau of Mines, seem to be about equal in merit.

*Draeger, 1907 Type.*—The Draeger breathing apparatus, 1907 type, has a knapsack, a pair of breathing bags, and either a helmet or a mouth-breathing device. The knapsack holds two steel cylinders charged with oxygen to a pressure of 1764 lbs. per square inch; a pressure gage (finimeter); a reducing valve; two regenerators containing caustic potash (ordinary lye); and a cooling cylinder.

The helmet incloses the wearer's face and top of his head, and is made to fit closely about his face by means of a rubber tube that may be inflated by pressing a small rubber bulb. The front of the helmet is closed by a circular disk of mica, protected by a wire frame. From the helmet are suspended two breathing bags, protected by a leather apron. The apparatus is so arranged that the mouth-breathing device may easily be substituted for the helmet.

The circulation of the air and gases within the apparatus is controlled by an injector that keeps a pressure in the supply or inhalation tube and a vacuum in the return or exhalation tube equivalent to 10 cms. (3.94 ins.) of water column. The reducing valve is so regulated as to furnish 2 liters (122 cu. ins., or about 2 qts.) of oxygen per minute. The injector causes the air within the apparatus to pass through the supply and return tubes at the rate of 50 liters (1.77 cu. ft.) per minute, so that the exhaled breath is quickly carried through the regenerator, where the carbon dioxide is absorbed, and then to the cooler and the supply tube. A relief valve attached to the helmet allows air to escape when the breathing bags become too full. The circulating system of the Draeger 1907 helmet-type apparatus is shown in Fig. 1.

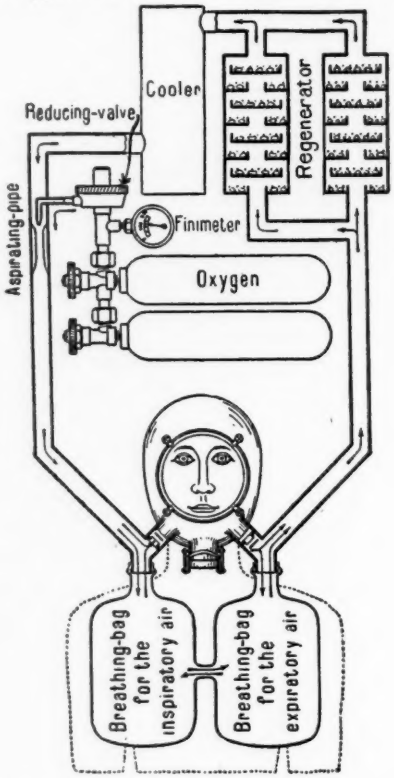



**Fig. 1. Circulating System of Draeger 1907 Helmet-Type Apparatus.**

*Draeger No. 2, 1910 Type.*—The 1910-type Draeger apparatus (Fig. 2) works on the same principle as the 1907 type, but is differently built. The 1910 type has the following parts: A knapsack with one oxygen bottle which contains, at a pressure of 2205 lbs. per square inch, oxygen enough for 2 hours' service; a reducing valve which regulates the supply of oxygen from the oxygen bottle; an injector nozzle which makes the air circulate; a pressure gage, readable by the wearer, which indicates the length of time the oxygen in the

*From Miners' Circular, No. 4, Bureau of Mines.

cylinder will last; a chest union to which are attached the circulating tubes and one breathing bag; a helmet or a device for mouth-breathing; a regenerator can (or cartridge), which contains potash grains arranged on shelves to absorb the carbon dioxide exhaled in the wearer's breath; and a tube for cooling the purified air.

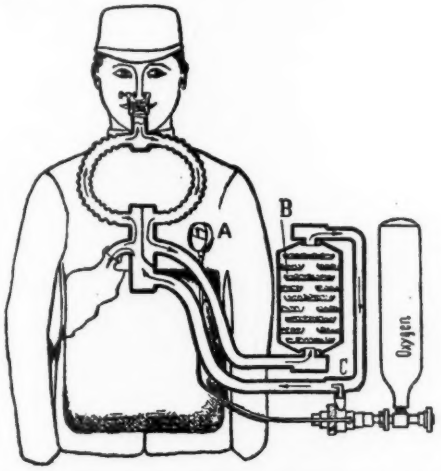



**Fig. 2. Circulating System of Draeger 1910-Type Apparatus.**

A relief valve on the chest union permits air to escape from the breathing bag when the bag gets too full. There are no valves in the circulating system. The helmet is of leather and has a mica window fastened in a metal frame. The facial tube is made to press against the forehead, the cheeks and the under side of the chin; it should not cover the temples. A more recent model of the 1910 type has two breathing bags, mica valves in the circulating system, and separate tube connections with the helmet for the inflow and outflow of air. A mouth-breathing attachment may be substituted for the helmet.

*Westfalia.*—The Westfalia breathing apparatus (helmet and mouth-breathing types) has, like the Draeger, a knapsack that is suspended from the shoulders and rests on the back. This knapsack has a frame supporting two oxygen cylinders, a regenerator, a pressure gage, a reducing valve, and an injector. Resting on the breast of the wearer are two breathing bags; one is connected to the oxygen supply tube and the helmet, and the other to the exhalation tube and the regenerator. The helmet, like that of the 1907-type Draeger apparatus, covers the front half and top of the head. A flexible rubber lining fits about the face and keeps out the external air, but for greater safety a rubber tube around the edge of the lining may be inflated by an attached rubber bulb. The mouth-breathing device may easily be substituted for the helmet.

The circulating system of the Westfalia helmet-type apparatus is shown in Fig. 3.

*Fleuss or Proto.*—The Fleuss (or Proto) breathing apparatus (Fig. 4) consists of a pair of steel cylinders or bottles, containing oxygen at a pressure of 120 atmospheres (1764 lbs. per square inch); a reducing valve

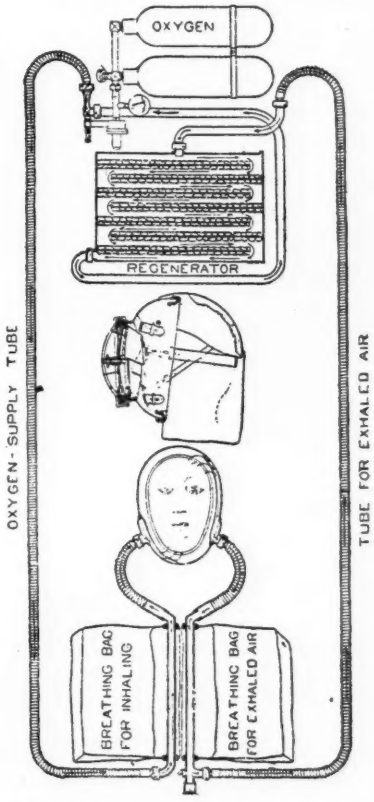



**Fig. 3. Circulating System of the Westfalia Helmet Apparatus.**

equipped with a by-pass valve; a breathing and regenerating bag that contains, when ready for use, 4 lbs. of caustic soda in sticks, a saliva trap, a cooler, and a relief valve; and mouthpiece, nose clip, goggles, and skull cap. A face mask that covers the nose and

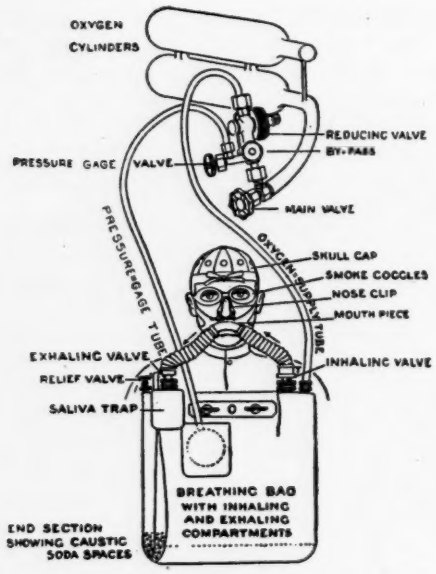



**Fig. 4. Circulating System of the Fleuss Apparatus.**

mouth may be used instead of the mouth-piece.

GOGGLES AND NOSE CLIP.

Goggles are used with the mouth-breathing patterns of apparatus only when a man has to work in smoke or in gases that affect the eyes. In the use of the mouth-breathing patterns of apparatus a clip is worn on the nose to close the nostrils. This clip has adhesive plasters which make it fit the nose firmly.

HELMET VERSUS MOUTH-BREATHING TYPES.

Men who have had much experience with breathing apparatus have different opinions in regard to whether masks, helmets, or mouth-breathing devices are the better. The writer thinks the helmet is not necessary for safe and effective service in unbreathable gases.

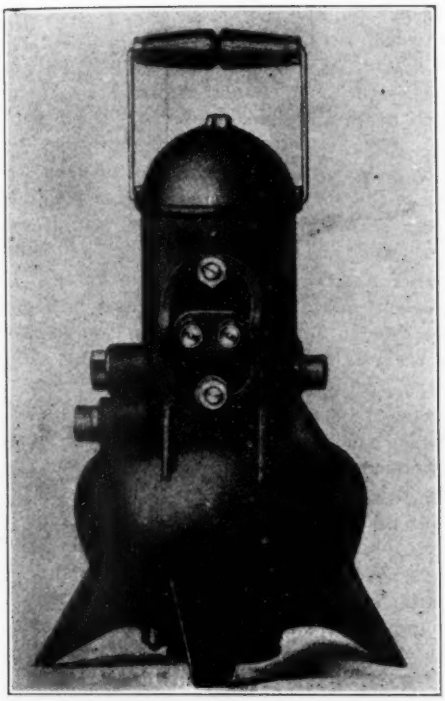
In an atmosphere that contains smoke or fumes that irritate the eyes, nostrils, or throat, the helmet may be worn with safety by one who has been thoroughly instructed and trained in its use, for the reason that any leakage may be readily detected, but in an unbreathable or poisonous atmosphere that contains no irritating fumes or gases a leak is not detected and the wearer may be overcome. The above disadvantage does not apply to the mouth-breathing form of apparatus, which the writer believes should be used for mine work in an atmosphere that will not support life and which does not contain irritating gases. In addition, the wearer of the mouth-breathing type can examine the roof more easily than can the wearer of a helmet. Some men who have used both helmets and mouth-breathing devices prefer the former, because they can breathe through the nose more easily than through the mouth. An objection to mouth-breathing devices is that they make it more difficult for men to talk to each other when working in a poisonous atmosphere, but audible signals may be used with success by men properly trained.

## JAPANESE PEARL DIVERS

The pearl divers of Japan are women. Along the coast of the bay of Ago and the bay of Kokasho the thirteen and fourteen year old girls, after they have finished their primary school work, go to sea and learn to dive. They are in the water and learn to swim almost from babyhood, and spend most of their time in the water, except in the coldest season from the end of December to the beginning of February. Even during the most inclement of seasons they sometimes dive for pearls. They were a special dress, white underwear and the hair twisted up into a hard knot. The eyes are protected by glasses to prevent the entrance of water. A boat in command of a man is assigned to every five or ten women divers. When the divers arrive on the grounds, they leap into the water at once and begin to gather oysters at the bottom. The oysters are dropped into tubs suspended from their waists. When these vessels are filled the divers are raised to the surface and jump into the boats. They dive to a depth of from five to thirty fathoms without any special apparatus and retain their breath form one to three minutes. Their ages vary from thirteen to forty years and between twenty-five and thirty-five they are at their prime.

## RESTRAINING THE USE OF COMPRESSED AIR

Perth Amboy, N. J.—The police have begun to enforce orders from Chief Burke, putting a stop to the use of putty blowers by the boys of the city. The chief has instructed his men to warn and later arrest on sight any boy or girl who blows putty through tubes of any sort.



## PORTABLE, AUTOMATIC, OIL-BURNING COMPRESSED AIR HEATER

The heater shown in the half tone and sectional cut herewith marks a new departure and a distinct advance in the working out of one of the most important problems in connection with the employment of compressed air for general industrial purposes. The considerable increase of volume resulting from the heating or reheating of air after compression and transmission, and the slight fuel cost of such reheating are generally understood and many heaters have been devised for the purpose, but various objections have prevented their extensive adoption. Perhaps the most frequent deterrent has been in the intermittent character of air employment. Heaters which would give very good results when the current of air was flowing constantly through them, as in the driving of a pump, have not proved so satisfactory in connection with rock drills or other intermittently operated tools.

The heater here shown, recently placed on the market, has sufficient capacity to supply one drill, and automatically maintains the desired temperature of the air passing through it. This is accomplished by the burning of gasoline or kerosene directly in the compressed air as it is passing through the heaters. The fuel is injected into the combustion chamber in the required quantity by the current of air passing through, so that the heating is automatically kept up while the tool is in operation and is discontinued when the tool is stopped. The mixture of fuel and air is ignited by an electric resistance coil or by a hot tube. It is stated that the only attention required is in the initial adjustment of the fuel valve to give the temperature desired.

The half tone, Fig. 1, shows a heater of

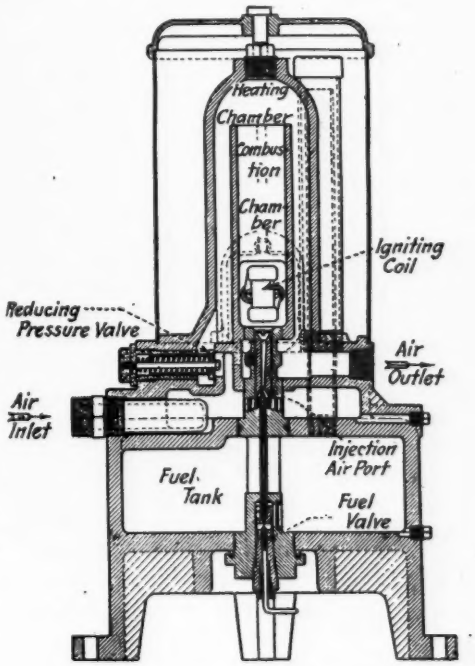



FIG. 2. SECTION OF LARGER HEATER.

small size, weighing only about 40 pounds and capable of heating air at the rate of about 75 cu. ft. of free air per minute. This would be enough for one rock drill up to, say 2½ in. Fig. 2 is a sectional view of a larger heater, having a maximum capacity of 250 cu. ft. of free air per min., enough for a 5½-in. drill. Its weight is about 150 lbs. The internal arrangement of both models is substantially the same. The supply line from the compressor is connected to the air inlet (Fig. 2) and the tool is connected with the outlet by a flexible steel hose. The metal

hose is necessary, instead of rubber, to withstand the high temperature (350 degrees F.) of the reheated air. The hose is insulated to reduce the loss by radiation. The entering air fills an annular chamber just above the feed tank at the base of the heater. From this space most of the air passes into the heating chamber through the pressure reducing valve set to maintain a pressure difference of a fraction of a pound. Due to this pressure difference, some of the entering air is by-passed up through the injection port, carrying with it oil from the tank below. A combustible mixture is formed and is lit by the igniting coil (or the hot tube) upon entering the combustion chamber above. The products of combustion mingle with the main body of air in the heating chamber and the heated air then passes from the outlet to the tool.

The heater is being put on the market by the maker, the Sterling Equipment Company, People's Gas Building, Chicago, under the name of the Sterling Air Economizer. It is claimed by the Sterling Company that 100 cu. ft. of air per minute can be heated from 50 degrees to 350 degrees during ten hours of continuous running with about 2½ gallons of gasoline or kerosene.

## DETERMINING THE SPECIFIC GRAVITY OF GASES

The following account is the description of an apparatus for the determination of the specific gravity of gases. The same follows the well-known Bunsen method, and depends on the law: That the squares of the velocities of two gases, flowing through a small orifice at the same pressure, moisture and temperature, are directly proportional to the specific gravity of the two gases. If

$s_1$=specific gravity of air;
$t_1$ = velocity of the air flow;
$s$ = specific gravity of the gas;
$t_2$ = velocity of the gas flow, then

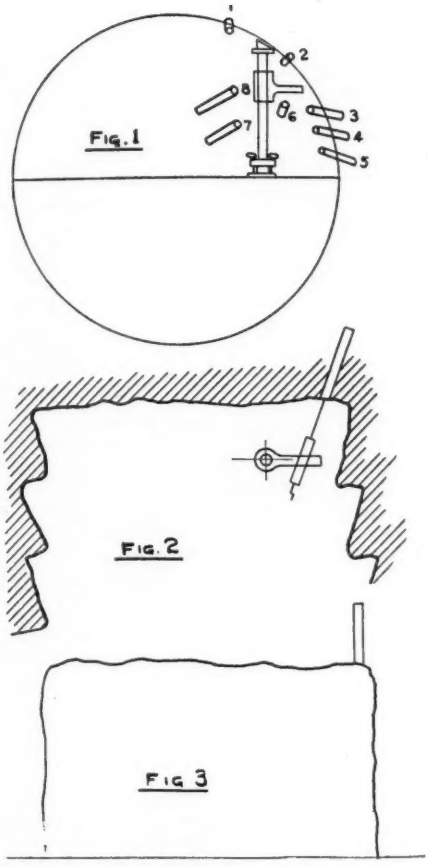
$$t_2^2 \div t_1^2 = s_1$$

And if the specific gravity of air equals one (1), then

$$s = t_2^2 \div t_1^2$$

In this new apparatus the flow of gas is in a vacuum whose height can be regulated accurately and kept within wide limits. It is therefore possible to determine the relation of the velocity of dry gases and get more accurate results. The apparatus is of glass, and consists of an upright cylindrical body, with manometer attached near top, the intake tube at bottom, the thermometer in the inlet pipe, the suction cock on the manometer exit, and cock on the manometer exit, and cock at the top of the cylinder. In the inflow pipe is a cock split in two chambers by a diagonal section. One of these chambers has a platinum sheet with a very fine orifice; the other is open and has no obstruction. The former serves to allow the test gas to enter. The manometer has a mercury column, and thermometer is attached in such a way that the mercury is enveloped by the inflowing gas or air. To use the instrument a vacuum is created in the vertical cylinder by means of a suction pump attached to the manometer cock. The mercury column in the manometer gives the height of the vacuum. When the vacuum is complete and the cock at the side of the cylinder is closed, the cock on the inlet is set properly, and air is admitted through the platinum sheet into the cylinder and the fall of the mercury column is watched to see when the vacuum shall have reached a certain lower value. The time of the inflow of air is determined by a chronoscope. Then the vacuum is again raised to the previous height, and the same process is repeated with the gas. The specific gravity and molecular weight are determined by the formula: Spec. grav. $= t_2^2 \div t_1^2$ and molecular weight $= 28.76 \times (t_2^2 \div t_1^2)$ (air = 1). If the gas to be tested is under pressure, the mouthpiece of the intake tube, as also the mouthpiece of the manometer, are connected to the gas main, so that there shall be a balance or equilibrium of pressure with the interior of cylinder. The excess pressure of gas over the atmosphere will be balanced in this way. A large number of tests were made with this inaccurate. The apparatus was tested with anthracite coal gas, oxygen, water gas, mixed gas, etc. An accurate even temperature of the gas is one of the necessities for a successful test. The apparatus can of course be made of metal as well as of glass.—Herr Gülich, *Journal für Gasbeleuchtung.* Translated by the *Progressive Age.*

The city of Rio Janeiro has a long distributing plant which employes three twin gas compressors of 2900 cu. ft. per min. capacity working at a pressure of 6 lbs., gage.




## LONG COLUMN ARMS IN TUNNELS

In driving tunnel headings of oval or semicircular cross section, ranging from 10 or 12 up to 18 or 20 feet in width on the floor, a customary method is to employ two columns, each carrying two drills. In order to complete the round and break the ground to the best advantage it is necessary either to move the columns or to set up a third column. A device for obviating this delay has been used recently with success in tunnels on the line of the New York City water supply aqueduct. It consists merely of a column arm of unusual length, 30 or 36 inches. This is set near the bottom of the column, and gives the drill a much wider range in placing the holes than the arm of ordinary length.

With this long arm a tunnel wall or rib may be carried straight, instead of as a series of offsets, with the resulting roughness, which must be reduced by filling or trimming. In the sketch, figure 1, is shown a column with a short arm. It must be set far enough from the rib to permit the arm to swing between the rib and the column when the arm is placed for drilling the holes at the top of the tunnel.

Hole No. 1 is drilled with the arm on the left side of the column. The arm is then swung to the position shown in the cut, and holes Nos. 2, 6, 7 and 8 drilled. If this arm or bottom arm of the same length is used for the lower rib holes, Nos. 3, 4, and 5 would be drilled as shown in figure 2, leaving an offset.

The use of a long arm on this column allows holes Nos. 3, 4 and 5 to be drilled as shown in figure No. 3, and the difference in appearance of the rib when the two arms are used is shown in figures Nos. 2 and 3. These are, of course, made of extra strong material to withstand the strain placed on them when the drill is working at the outer end.—*Mine and Quarry.*

## DETERMINING VERTICAL MOVEMENTS OF AIRSHIPS

To determine his precise position at any time the marine navigator has only to know his latitude and longitude. The aerial navigator, for personal safety as well as for successful voyaging needs also to know not only his altitude, which the aneroid barometer will tell him approximately, but also on the instant he should know whether he is rising or falling. Engineer Philip Lens, of Gross-Lichterfelde, Germany, has recently produced a device for this purpose. His signal apparatus consists of a rectangular wicker basket, in which a wind wheel is placed vertically. By means of a lever connected with the axis of the wind wheel, two sounding mechanisms are set in motion as soon as the little wheel revolves. The bottom and top of the complete instrument are provided with openings so that the air can enter either way. As soon as the balloon changes its altitude, an air current flows into the signaling instrument, setting the wind wheel in motion, and with it the sounding mechanism. In order to render the device useful for motor airships, the top and bottom of it are provided with a wire gauze as shields against the vertical current caused by the propeller.

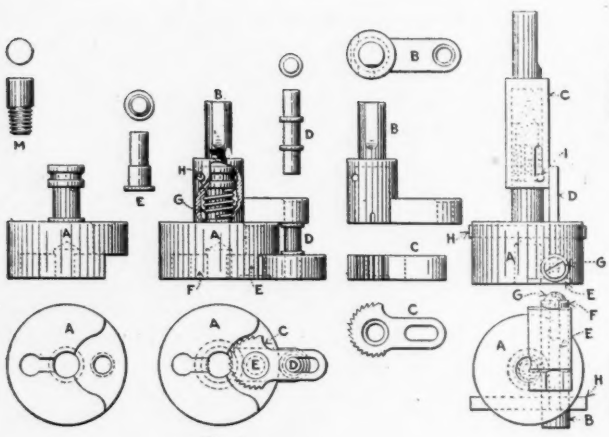



Fig. 1

THE CHUCK FOR DRILLING

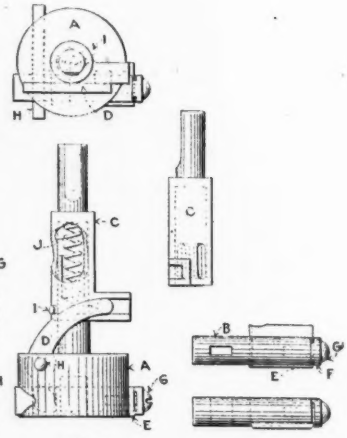



Fig 2

THE CUTTING-OFF TOOL

## SPECIAL TOOLS FOR ROTATING AIR DRILLS

In the accompanying cut, reproduced from the *American Machinist*, are shown in complete detail some special tools invented by Mr. William D. White and used with great success in the Montreal shops of the Canadian Pacific Railway.

At the time of their production this road was engaged in the work of replugging the numerous gas tanks carried underneath its passenger cars. Each tank contained from fifty to seventy-five ⅜-inch holes, which were formerly filled with lead as a preventive of explosion in case of fire. On the introduction of a new nonexplosive gas, the lead-plugged holes in the tank had to be replaced with brass plugs.

This represented no small amount of work, as there was a large number of cars with two tanks each.

The lead was first drilled out of each hole by means of the air drill, and tapped with a ¼-inch pipe tap. The plugs, made of 7/16-inch diameter brass bar cut off 1 inch long and threaded one-half their length, were next inserted in the holes by one man, while the second followed with an air drill and the chuck, Fig. 1.

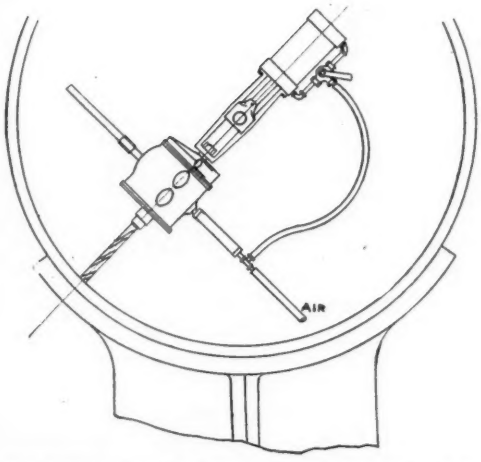
In Fig. 1, *A* is the body proper, and *B* the shank with a proextension at the side, into which is fastened the post *D*. The eccentric gripping piece *C* is made of cast steel and hardened. Pin *H* holds the shank *B* to the body of the chuck by engaging the groove cut on the proextension of the body *A*.

The spring *G*, being fastened at one end to the shank, *B*, and at the other to the post on the body of the chuck, causes the shank *B* to be carried to the left and the eccentric gripping piece *C* with it by means of the post *D*. Thus the chuck is always held open to receive the end of the brass plug *M*. In operation, the shank *B* is carried to the right, thus causing the eccentric gripper to grip the end of the plug inserted in the chuck. The hardened-steel piece *F* also assists in gripping and holding the work.

After the plugs are screwed in, the projecting end is cut off by means of the tool shown in Fig. 2. This is accomplished by a downward pressure on the air drill as the tool is driven by it and revolves around the end of the brass plug. The cutter held in the sliding bar *B* is forced against the plug until the corner of the cutter reaches the center, when the plug is cut off flush with the tank. The lever *D* serves to engage the shank *C* with siding bar *B*. Thus a vertical reciprocating movement of the shank *C* causes a horizontal reciprocating movement in sliding bar *B*.

The spring *J* serves to hold the tool open to receive the work. The pin *I* holds the shank *C* on the body of the chuck and also prevents it from turning on its pivot.

Two men turned out 16 tanks a day with these tools, whereas four men without the tools turned out only four tanks per day.




## PNEUMATIC FEED FOR AIR DRILLS

By F. G. Goddard.

This device was designed for drilling locomotive saddle bolt holes in the erecting shop after the boiler is in place, at as high a rate of speed as could be obtained in the machine shop on a radial drill. A small air cylinder fitted with piston, guide-bars and crosshead is attached to an air motor by means of a coupling, Fig. 2, screwed into the motor in place of the usual feed screw. This coupling is also attached to the end of the guide-bars in such a way that the motor is free to rotate on its axis, this condition being necessary to relieve the guide-bars of all twisting strain when drilling

When in operation, a 2 inch round bar or pipe of extra heavy section is rigidly stayed in the centre of the smokebox by means of two spiders, Fig. 3; the motor and cylinder being suspended between the spiders on the bar which passes through a 2 inch hole in the crosshead. The air supply to the cylinder is tapped off the motor supply by means of a tee and short length of hose to a three-way cock on the cylinder. It can be manipulated to give exactly the requisite amount of pressure to feed the drill; or on being reversed, backs the drill out of the hole. As the crosshead and piston are attached to the 2 inch bar, they remain stationary when air is applied; but the cylinder moves either up or down, and with it the guide-bars and air motor. It will be noticed that every hole thus drilled is perfectly radial from centre of the smokebox. The apparatus was so designed that drills of average length could be used in smokeboxes of the smallest diameter; consequently in those of larger diameter drill sockets or extensions must be used to make up the length, so that the point of the drill swings 1 or 2 inches clear of the inside of the smokebox when in the back-up position.

When drilling, the motor should be at its full speed before any feeding pressure is applied, and a chalk mark should be put on the drill to show when it is about to point through the outside of the saddle, at which juncture the air feed must be shut off and the drill allowed to go through by its own weight, otherwise it is liable to jam or break the point of the drill. If properly handled and using high

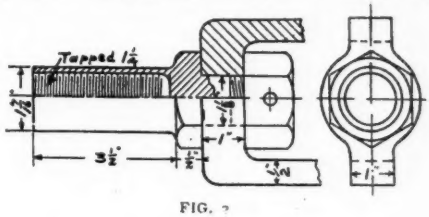



FIG. 2

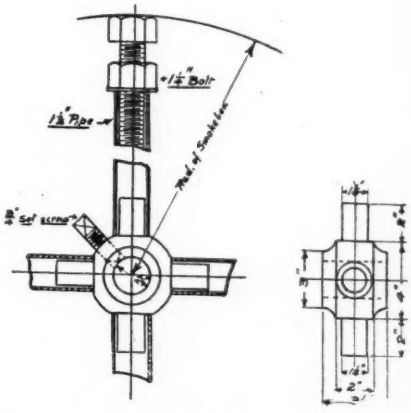



FIG 3

speed drills, saddle-bolt holes can be drilled in this manner at the rate of one every 1½ to 2 minutes, and the time required to change from one hole to another is but a few seconds. The device was originally intended for use in the case of new cylinders being applied to a repair engine, but it was afterwards found that a great saving in time could be effected in the case of new engines, by punching the holes in the smokebox, before rolling, and then drilling the saddle as described after the boiler is in place on the cylinders. It has also

been used to advantage for drilling out old saddle-bolts when stripping boilers.

The correct size of cylinder was only arrived at after one of two trials. Finally, a diameter of 5 inches, with an air pressure of 70 to 80 pounds was found to give a fairly heavy feed to high speed drills up to 1½ inches diameter. The stroke of the cylinder is 8 inches.—*Canadian Machinery.*

## THE PULLMAN PORTER DERANGES THE AIR BRAKE

The following is taken from a collection of "Old Line Railroad Reminiscences," by S. J. Kidder, in *Railroad and Locomotive Engineering*:

On several occasions an express train had been stopped by an apparently unexplainable application of the brakes, the brakes releasing after the stop and giving no further trouble during the trip. Three times this had occurred on the same railroad and train before it had come to my attention, and I at once started out on a still hunt during which it was learned that Pullman car "Wyoming" had been in the train each time the trouble was experienced and with the same porter accompanying the car.

This was in the early days of employing the water raising system on Pullmans, the air for the system being taken direct from the air pipe, the control of the air passing from the brake pipe to the large air reservoir being governed by a globe valve located in the washroom, under the basin. To avoid possible interference with the air brakes a notice addressed to porters was posted in the room, this notice being to the effect that the water system should never be charged, except when the train was making a long stop, such as a station where the passengers were taking a meal. Believing I was on the right trail, I accompanied the "Wyoming" on its next trip. Getting along quite late in the night others deserted the smoking room, leaving me the sole occupant, and after a time the porter came in with his shoe-shining outfit, when I began making inquiries regarding the water system. What made the water flow from the faucets so freely, etc., all of which the porter explained, and, among other things, he stated if the water did not come out fast enough he just opened up the valve and filled everything with air.

"Don't you porters ever have that hungry feeling when the train is standing at an eating station, as well as the passengers," I asked.

"Sure, I does, boss; I always carries my appetite along with me," he replied.

"I should think you would want to reach the lunch counter when meals are being served as well as the others."

"I don't go without my feed, no Sar. I just sneaks out here when there ain't no smoking gentlemen, and turn that wheel, and no one don't know anything about it. I has just done been in this business too long to lose my fodder."

"If no one knows anything about your fixing up the water outfit, why is it that the train sometimes stops when you open that valve?"

"That's the funny thing about it, boss. When the train stopped, I done shet up that wheel and got off, and while we was hunting for the trouble the brakes all blowed off."

I then called his attention to the notice, explaining to him that the opening of the valve was the cause of the train stopping and, of course, would have to make out a report to that effect.

Upon making this statement his eyes bulged, and throwing up his hands, he exclaimed, "For the goodness sake. Was that me making that train stop?" Then he began supplicating that he would lose his job, saying if I would not report him he never again would disobey the rules governing the manipulation of that globe valve, a promise I gave with the proviso that he should explain to the other porters the danger of charging the water raising system when the train was in motion, a promise he faithfully carried out.

For reasons such as the one here recited the development of valves to automatically maintain the desired pressure in the water distributing system resulted, thus removing any liability of interfering with the action of the air brakes.

---

A simple muffler for a gas engine may be made by leading the exhaust pipe into the bottom of a barrel, filling the barrel with scrap tin, and putting in the head, through which a hole is cut for the outlet pipe. The tin breaks up the sound waves, and thus the noise is muffled.

# COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - Editor
FRANK RICHARDS, - Managing Editor
F. C. IGLEHART, JR., - Business Manager
W. C. LAROS, - - Circulation Manager

PUBLISHED BY THE

Compressed Air Magazine Company
Easton, Pa.

New York Office—Bowling Green Building.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XVI. NOVEMBER, 1911. No. 11


CONTENTS


Special Drills on Barge Canal..... 6219
Mine Ventilation on the Rand..... 6223
Bottom Heading Tunnel Driving..... 6224
The Air Pump Valve Froze..... 6229
Expansion Gear for Air Hammers..... 6230
Types of Mine-Rescue Apparatus..... 6230
Japanese Pearl Divers..... 6234
Restraining the Use of Compressed Air.. 6234
Portable Compressed Air Heater..... 6235
Determining Specific Gravity of Gases.. 6236
Long Column Arms in Tunnels..... 6237
Indicating Vertical Movements of Airships 6237
Special Shop Tools for Air Drills..... 6238
Pneumatic Feed for Air Drills..... 6239
Pullman Porter and the Air Brake..... 6240
Pneumatic Tool Progress..... 6241
Blowing Engine Progress..... 6242
Increase of Coal Mining Machines..... 6242
Truth About a Drill Contest..... 6242
*Small Motors* ..... 6243
Diminished Atmospheric Pressue..... 6243
Pole Preserving Apparatus..... 6244
Weather Forecasting Competition..... 6244
Sand Manufactured for the Sand Blast.. 6245
Pneumatic Caissons for Quicksands..... 6245
Notes ..... 6246
Patents ..... 6248


## PNEUMATIC TOOL PROGRESS

A "pneumatic tool," taken individually, is nothing very formidable to look at, and hardly suggests the revolutionary effects following the general introduction of the class of devices which it represents. Only a few years ago lists were being made up of the various tasks which compressed air was undertaking and most successfully accomplishing in practically all lines of human activity, but the list became so large and was growing so rapidly that the enumerators could not keep up with the times and the sport was dropped. It would now be almost as discouraging to try to mention all the employments of the pneumatic tool alone, although it is only a single item of the compressed air kit.

The pneumatic tool is transforming the old-time trades so that the highly developed skill of the workman so requisite in many of them is now a thing of the past, and the workman himself is displaced by the operator. One of the most tedious and constant of the tasks of the machinist of the olden time was the chipping of iron, generally cast iron; this the pneumatic tool now does so much quicker and cheaper, also smoother and better, that the knack of doing it by hand is likely to be forgotten. The rolling up of long, unbroken chips or shavings of soft steel, which the pusher of the pneumatic chisel often can show, is a new art to replace some one of those sentimentally lamented as "lost." Requiring more muscle but less skill, perhaps, was the pulling of the ratchet drill and the tap-wrench, which also the machinist is now pneumatically released from.

The trade of the boiler maker has been entirely transformed by the pneumatic tools which have been put into his hand until there is scarcely a straight hand-work operation surviving. Probably few realize the skill of the expert boiler maker in "driving" the hot rivets by hand and producing the beautiful, smooth, symmetrical, conical heads. Such skill may become a tradition and then a myth. The machined or pneumatic-tooled rivets are better to look at, after all.

The noise of the hammer has not been eliminated, but little else survives, and we hear it constantly as the skyscrapers are going up. The rapidity with which the steel skeletons grow is due to the pneumatic riveters, as well as to the derricks.

Hand hammering throughout the trades, from the driving of nails to the forcing into place of heavy pins and bolts in machine erecting, is becoming a "has been," and the mutilating dents of the hand hammer need no longer be tolerated.

The pneumatic hammer is not more efficient, and ultimately is not more a necessity in the metal trades, than in the other industries where skillful or merely persistent applications of force to cutting tools in detail is required. Stone carving is one of its greatest successes, the most delicate and difficult designs of the sculptor being reproduced in granite or marble with a facility which the ancients could not have dreamed of. The stone-cutting ability is now found just as handy and valuable in cutting asphalt, concrete or macadam where street pavements are to be torn up for any of the modern "improvements."

The percussive pneumatic tool follows in principle the hand operation, the chisel or other bit being held tight against the work and the hammer blows being showered upon the head of it. It is curious that the first, and now established, pneumatically-operated rock drills radically departed from this idea, the cutting bit and the hammer all reciprocating and striking the blow together. These drills, as we know, have been a success the world over; but later the pneumatic tool, embodying the primitive idea, has been replacing them among the miners, and none can say what will be the end of it.

## AMERICAN BLOWING ENGINE PROGRESS

Twenty years ago the simple vertical, long crosshead type of blowing engine was installed at a group of four blast furnaces. About eight years after, half the group of engines were replaced by larger machines with large steam cylinders, so as to operate them as disconnected compound units. In fifteen years' time from the start they were superseded by improved forms of compound engines. About two years ago the new engines were assisted by gas-driven blowing engines using blast-furnace gas, with the implied intention of displacing all steam blowing engines. Now arises the specter of the turbine-driven blower. Fundamental changes in the iron and steel business imposed these changes and not the mere "obsolescence" of the elements of the power plant. Other lines of industry, not excepting the business of furnishing electric current, have exhibited similar crises in their development.

## INCREASE IN USE OF COAL MINING MACHINES

According to E. W. Parker, of the United States Geological Survey, 174,012,293 short tons, or 41.7 per cent of the total output of bituminous and lignite coals, was mined by machines in 1910. This was an increase of 31,515,415 short tons over the amount so mined in 1909. The number of machines operated in 1910 was 13,254. The use of machines not only makes the miners' task easier but, according to Mr. Parker, reduces the tendency, too prevalent in many coal-mining districts, to "shoot from the solid," a practice that not only increases the liability to accident but produces an inordinate quantity of undesirable and unmarketable fuel. It is gratifying to note, says Mr. Parker, the steady increase in the proportion of coal mined by the use of machines, for it indicates a larger proportion of coal undercut before being shot down.

## SOUTH AFRICAN DRILL CONTEST

The following letter in the latest-to-hand issue of the South African Mining Journal, with the appended note by the editor of that publication, seems to be entirely self-explanatory and will be read with interest.

To the Editor South African Mining Journal:

Sir—I enclose a small circular, entitled "Results of the Stope Drill Contest," which from its appearance was published by your journal, and quoting from your issue of June 14th, 1910, this being circulated in the United States as an advertisement of the Holman rock drill. This was no doubt unintentional, but the general impression is very misleading. It would give one the impression that there were 4,000 Holman prize-winning drills in use on the Rand. The truth is that of all the various drills that entered the Stope Drill Contest there are probably few in actual use on the Rand to-day, including the Siskol and Holman drills, between whom the prize money was divided. These drills were all small, the Holman only 2⅛ in. diameter of cylinder, and

only weighed 100 lbs. The smallest drills being installed on the Rand to-day have cylinto 200 lbs. Furthermore, this circular does ders 2½ in. to 2¾ in., and weigh from 140 lbs. not mention that some of the largest of the drill manufacturers did not enter the contest, as they considered that 100 lbs. was too light a weight for a stoping drill, and therefore did not enter the contest at all. Again, the fact that very few of these drills are in operation here now, proves conclusively that this contest accomplished nothing more than proving that a 2⅛ in. reciprocating drill of the Holman type and weight, though it shared the prize, was *not* the ideal stope drill for the gold mines of South Africa. I have taken the liberty of calling this to your attention, as I do not think that a journal of your standing would care to mislead any mining men in so important a case as this is. Yours, etc.,

"ENGINEER."

September 12, 1911.

[The foregoing letter refers to a pamphlet being circulated in the United States, claiming to consist of extracts from the South African Mining Journal of 4th June, 1910. This pamphlet was not issued from our office, does not quote us correctly and has been published without our knowledge.—Ed. S. A. M. J.]

## SMALL MOTORS

We have received the first issue of a neat little monthly publication bearing the above title put out by the Westinghouse Electric and Manufacturing Company, its scope being clearly indicated by its title. It is devoted to the innumerable and widely diverse applications of small electric motors, for industrial and domestic purposes with information and advice as to installation, operation, upkeep, etc. It is to be destributed to central stations and dealers the first of every month.

## OUR DIMINISHED ATMOSPHERIC PRESSURE

The following curious and rather interesting line of speculation is to be credited to *Cosmos*:

Among the animals which people the earth we find representatives of all sizes, from the microscopically small animalcule to the great elephant. But within the limits of any one species the scale upon which the individuals are built does not differ very materially; we do not, for example, find specimens say ten times larger than their adult congeners.

It is easy to show good mechanical and physical reason why this should be so. Consider two birds, geometrically similar, such as two swallows for example, and imagine the second to have ten times the normal size. This bird will then have all its linear dimensions ten times as great as the normal bird, while the surfaces will be one hundred times as great. In this way all the cross sections, the thickness of the muscles, especially of the wing muscles, being increased one hundred fold, we may safely take it that the strength of the bird will also be increased in the same proportion. But on the other hand, it must be remembered that the volume, and hence the weight of the body, will be increased one thousand fold. Thus this large swallow, built on ten times the normal scale, would find itself quite unable to rise into the air or to sustain itself there, for it is relatively ten times less strong than its congeners; with muscles one hundred times as strong as theirs it is called upon to perform one thousand times the work.

As a matter of fact, an examination of the flight of different kinds of birds having approximately the same form shows that flight becomes more and more difficult as the weight increases; large birds substitute as far as possible sailing flight (which is the characteristic motion of our aeroplanes) for flapping of wings. Thus the size of animals capable of flight has an upper limit, and this seems to be reached, in the present state of nature, by the large birds, so far as sailing flight is concerned, and by the large insects, so far as flight by wing vibration is concerned.

And yet in past ages much greater animals have flown. One reptile of the group Pterodactyl had a span of over thirty feet, which exceeds that of a racing Blériot; this creature lived during the cretaceous period and flew as far as 90 miles inland. Certain dragon flies of the carboniferous era measured over three feet from tip to tip of their outspread wings. Under present conditions it would be quite impossible for these creatures to fly. The most natural supposition is that in the times when these creatures flew through the air, the atmosphere had a greater density

than it has at present. This is the conclusion reached by Mr. Harle. In the estimation of this paleontologist, the existence of these great flying animals during cretaceous and carboniferous times indicates that atmospheric pressure at that time was greater than at present.

## A POLE PRESERVING APPARATUS

The life of wooden poles for telephones, telegraph and transmission lines is shortened by their rapid decay at or near the surface of the ground, and if this local decay can be prevented or even retarded, the life of the pole is proportionally lengthened. Effective preservatives have been found for the wood, but painting the surfaces or even dipping the ends of the poles is not sufficient and a portable apparatus has been devised which secures a certain and effective penetration of the fibre.

The machine as constructed comprises a platform about 19 ft. long and 6 ft. wide, mounted upon wheels for drawing about, and upon this platform are placed a steam boiler, an air compressor and air storage tank, a closed oil tank with steam coils, and an air-tight canvas band or belt 3 ft. wide to enclose the portion of the pole which is to be treated. There are also the necessary devices for wrapping the band about the pole and making it tight. A pole to be treated is rolled onto the platform and rests upon two horizontal beams fixed at the proper height, and two segmental stationary rings have their upper halves closed over the pole. Then a spindle carrying the canvas strip is revolved on the rings about the pole, and a clamping bar converts the belt into a closed bag. Air pressure is applied to the edges of the band to close it around the pole and then the oil is forced through a pipe connection into the bag and around the pole, pressure being held on for any desired length of time. Should any oil leak by the ends of the bag, through cracks or checks in the wood, it would drip into a catch basin and might later be drained into the oil tank. By reversing the above operations, the pole may be released and taken away on the other side of the machine. Where a large number of poles have to be treated, a platform may be built on either side of the machine, or any desired construction made for ease in bringing poles to the machine. For a small number of poles in any one place, inclined skids may be placed on each side of the machine. The capacity of the machine is claimed to be about 50 poles per day. The cost of treating, including labor, oil, fuel and fixed charges, is something less than $1 for a 35-ft. pole, with a 7-in. top.

At a demonstration of the process and apparatus, which was given recently in Chicago, three 35-ft. Michigan cedar poles, cut last winter, were treated 7, 10 and 15 minutes, respectively, with hot creosote oil, under an air pressure of about 5 lbs. With the 10 minute treatment an initial penetration of 3/16 in. was obtained, and in a few days this had increased to over ½ in. The treated belt was 3 ft. wide, and 1 gallon of oil was absorbed.

It is stated that both the process and the equipment are patented, the latter being manufactured by the B. & E. Pole Preserving Machine Company, 2014 Fisher Building, Chicago.

## A WEATHER FORECASTING COMPETITION

The Société Française de Navigation Aérienne has decided to organize a competition in weather forecasting, which will extend over a period of two weeks about the time of the vernal equinox of next year. This season was selected because it is supposed to be characterized by generally unsettled weather, and therefore likely to afford a servere test to the competitors. An elimination contest, the particulars of which have not yet been announced, will precede the principal competition, its object being to shut out the cranks and charlatans who might be disposed to participate in such an event.

The idea of a public contest in weather forecasting is not new. In the autumn of 1905 a competition of this sort was held by the Société Belge d'Astronomie for a prize of 5,000 francs. The competitors were first required to make daily forecasts based on the current weather maps published at the various meteorological centers of Europe; these were submitted by telegraph and registered mail to the jury assembled in Belgium, the members of which were all well-known meteorologists, viz., Messrs. Teisserenc de Bort, Rotch, Polis, Brunhes, and Vincent. From the twenty-four contestants the seven who submitted the most accurate forecasts were summoned to Liège to

take part in a further test. Each of them was required to make a series of forecasts for a twenty-four hour period based upon seven weather maps selected at random from those published by the French meteorological service between the years 1880 and 1902. The jury, having at hand the maps for the days succeeding those selected, was able immediately to verify the accuracy of the predictions.

This second test resulted in the further elimination of four competitors, and the remaining three were then required to furnish a statement of their methods of forecasting. The jury unanimously awarded the prize to M. Gabriel Guilbert, of Caen, France, both for his successful forecasts and for his method, which was then first made known to the scientific world, and attracted wide attention. —*Scientific American.*

## SAND SPECIALLY MANUFACTURED FOR THE SAND BLAST

There are, as they say, sands—and sands. Not all sands are effective with the sand blast, and, indeed, some would be perfectly worthless for the purpose. The use of the sand blast is constantly increasing and its specific applications are becoming more numerous. One of its most extensive fields of activity is in the cleaning of castings in the foundry. Fabricators of structural material are installing the system for cleaning sections before painting so as to insure a clean surface and to thereby further retard corrosion. Tank works and similar manufacturing establishments are likewise installing this equipment and with the growing use of this device there has been a correspondingly increased demand for sand blast sand.

Heretofore much of this sand has been shipped from the east, where it is dredged from the Atlantic ocean. A large deposit of silica rock, which is unusually well-adapted for sand-blasting purposes has been uncovered in Portage county, Ohio. This deposit is owned by the Portage Silica Co., Youngstown, O., and consists of practically 900 acres. The rock is now being mined by this concern and a large crushing and disintegrating plant, as well as washer and dryer, have been installed.

The sand blast sand can be furnished in six grades adapted for various classes of work, the coarser grade being specially suitable for use in cleaning castings which are to be subsequently enameled. The finer grades are adapted for cleaning aluminum and brass castings, and other grades are suitable for gray iron and steel castings and rolled steel products of all kinds. The company's mines and sand-preparing plant are located on the Erie railroad and the present output averages from 400 to 500 tons daily. The dryer installation permits of the shipment of dry sand at any time of the year, thus precluding the necessity of foundries carrying a large stock of sand during the winter months.

## PNEUMATIC CAISSONS FOR DRY DOCKS IN QUICKSAND

The dry-dock construction in the Brooklyn navy yard is one of those complicated pieces of work which deserve to be described by a literary master like Kipling, for the struggle that is going on there between the treacherous quicksand and the men in charge of the work is something wholly outside the ordinary run of engineering undertakings. Every dry-dock in the yard has caused its builders constant worry, but the new one has a particularly cantankerous record of disaster. Those who are unacquainted with the site can hardly imagine the difficulties. The place is underlaid by very fine material possessing most of the characteristics of quicksand, although some engineers have hardly classed it as such. Whenever a large excavation is made in it subsidence occurs in the vicinity. The earlier contractors on the dock conducted the work in the open, and before they retired a number of buildings in the vicinity were injured by the settlement of their foundations. Attention has been called from time to time of the warning against such methods given years ago by the builder of the first dry-dock in the yard, the late William J. McAlpine. His experience showed him that it was impossible to execute more than a small piece of the structure at a time, but that the concrete could be put in piecemeal by concentrating the work on small areas. The new dock, after a long record of disappointments and tribulations, is now being executed in just this way, but by means which were outside the resources of Mr. McAlpine. The construction of such a dock is essentially a foundation problem, and the

work is now being executed successfully by employing that most important resource of foundation specialists, the pneumatic caisson. This is essentially a means for concentrating construction on a small area under the most favorable conditions, and the work in progress in the Brooklyn navy yard is a singularly vivid exemplification of the progress in such matters since the first dock was constructed. That the troubles have by no means been wholly overcome is very probable, but enough of them have been encountered and bested to indicate that the new dock can be constructed without any more serious results to adjacent structures.—*Engineering Record.*

## NOTES

Politeness may be only "hot air," but an air cushion makes a mighty good "shock absorber."

Tarred-paper gaskets will be found effectual when an air or oil paint persists in leaking. They may also be used on the flange joints of an air compressor. They are much better than lead gaskets.

The cost of a loft building of reinforced concrete, recently completed on Forty-second street, New York City, is reported to have been 11 cents a cubic foot, including the ornamental front, the heating plant, lighting, elevators and plumbing.

In round numbers a stream having a flow of one cubic foot per second will generate one theoretical horse-power for every 10 ft. of fall it has. Thus, a stream flowing 4 cu. ft. per second, and having a fall of 30 ft., could generate 12 theoretical horse-power.

The lung capacity of the average woman who does not wear corsets is about 2800 cubic centimeters or 171 cubic inches; of one who is in the habit of wearing corsets only 2,200 cubic centimeters or 134 cubic inches.

A feature of the mine safety demonstration at Pittsburgh this month will be a parade of miners, with 19,927 men in line. This is the number of men killed in America coal mines during the last 20 years, and the parade was designed both as a mark of respect to the dead and to add impressiveness to the figures of mine fatalities.

A jet of compressed air directed against the heated ends of work that is being forged will revive the heat and also blow off all dirt and scale.

An English report says that the use of pitch as a binder in the briquetting of coal has developed a disease known as epithelioma (pitch cancer), from which an alarming percentage of the briquette workers suffer. A government inquiry is to be held, the result of which will be published as a special report.

Screw connections may be made tight by using powdered shellac dissolved in 10 per cent. ammonia. The mucilaginous mass is painted over the screw threads, after they have been thoroughly cleaned, and the fitting is screwed home. The ammonia soon volatilizes, leaving behind a mass which hardens quickly, makes a tight joint, and is impervious to hot and cold water.

The condition of iron in lime concrete after a period of more than 200 years was determined when an opening was made recently in the concrete of the dome of St. Paul's Cathedral, London. A large chain used for reinforcement at the base of the dome was found to be as bright and perfect as when new. One reason advanced in explanation of the condition is that the oxide of iron chemically combines with the cement, forming a covering of ferrite of calcium, which is a protective agent.

It has been shown that oil with a flash point of 239 deg. Fah. will not ignite if fired into with a shell, and if dynamite is exploded in a reservoir of this oil, it only throws up jets of oil which do not ignite. The only dangerous liquid fuel oils are those which have not parted with their volatile, inflammable gases, such as absolutely crude oils. In all ordinary commercial fuel oils these portions are removed, and the oil is safe and contains no power of spontaneous combustion. Oil with a fire test of 180 deg. to 200 deg. Fah. is as safe as coal, and it will not ignite when

stirred with a red-hot poker, nor when hot-coals are thrown in it.

---

One ton of refrigeration is the amount of heat absorbed by the melting of 2000 pounds of ice at 32 degrees Fahrenheit into 2000 pounds of water at 32 degrees Fahrenheit, or the amount of heat that must be extracted from 2000 pounds of water at 32 degrees Fahrenheit to reduce it to 2000 pounds of ice at 32 degrees Fahrenheit, or 2000 × 142 = 284,000 B.t.u.

---

It is proposed to hold a Smoke Abatement Exhibition in London next spring. It is the outcome of the success achieved by recent exhibitions in the country, many manufacturers having expressed a desire that steps should be taken to hold in London an international exhibition of a more comprehensive character than is possible elsewhere. The exhibition, which is being arranged by the Coal Smoke Abatement Society, will be held at the Royal Agricultural Hall, and will last a fortnight.

---

An efficient air filter should be considered a necessary part of the equipment of every motor car. That a large amount of dust does actually enter the air inlet pipe has been proved by an experimenter who purposely refrained from using a duster anywhere inside the bonnet. As a result, the whole of the mechanism within the bonnet—cylinder, magneto, carbureter, piping, etc.—was thickly covered with dust; and as the inlet pipe draws its air supplies from within the bonnet it is obvious that a large amount of this dust becomes mixed with the lubricating oil inside the cylinders, where it is acting as a grinding material for destroying the bearings and the accurate fit of the pistons in the cylinders.

---

The possibilities of Spitzbergen are attracting. considerable attention since the Arctic Coal Co., owned by American capitalists, has achieved some success in exploiting the coal resources of the island, which is located within the actic circle and is uninhabited save by those engaged in the mining operations. It is stated that the Arctic Coal Co. shipped some 30,000 tons of coal from the island during the open season of navigation which is now about to close, and expeditions have recently been sent to Spitzbergen by Swedish and English capitalists to study its coal deposits and other resources. It is a no man's land, claimed by no government and without an owner of any kind.

---

The Nepton tunnel, now being driven in the Pachuca, Mex., district will be one of the longest mining tunnels in the world. It will be over 6 miles long when finished, and lies at a depth of about 1,400 ft. below the surface of the city of Puebla. Though started 18 years ago, only about 2 miles of the length has been finished. The tunnel is to drain the Pachuca mining district and afford an outlet for the ores of the different mines.

---

In the suction pumping of water not only should variations of altitude and, consequently, of air pressure be taken into consideration, but the engineer should take account of any decided variations in the temperature of the water. With the volatilization of water the vapor overcomes the vacuum condition upon which the elevation of the fluid by suction is dependent and materially reduces the possible head at which the pumping is carried on. It has been computed that at a water temperature of 180 degrees F. at sea level a safe suction head is less than 13 ft., while with the same temperature of water at an altitude of 5,000 ft. the safe head is 8.2 ft., compared with a head of 20.5 ft. at 60 degrees F. and an altitude of 5,000 ft.

---

In breathing ordinary air a man consumes from 10 to 35 per cent. of the oxygen that passes into his lungs; the rest he exhales with the nitrogen he inhaled and the carbon dioxide produced in his lungs. The exhaled breath contains 2.6 to 6.6 per cent. of the suffocating gas carbon dioxide, or an average of about 4 per cent. The percentage does not change much, whether the air breathed contains a high or a low percentage of oxygen, so long as a man breathes freely. But when a man breathes air that contains as much as 5 per cent. of carbon dioxide, even if it contains a high precentage of oxygen also, he begins to breathe with effort, his head aches, he feels dizzy, and he may have pains in the chest. The same difficulty in

breathing may be felt when a man breathes air containing as little as 14 per cent. of oxygen. Air that contains 10 per cent. of oxygen is extremely dangerous, for it will quickly suffocate anyone breathing it.

## LATEST U. S. PATENTS

***Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.***

SEPTEMBER 5.

1,002,249. ELECTRICAL OXIDATION OF NITROGEN. CARLETON ELLIS, Montclair, N. J.

1,002,295. AIR COMPRESSOR AND DISTRIBUTER. MICHAEL G. McGUIRE, Chicago, Ill.

1,002,324. VACUUM CLEANING DEVICE. GEORGE JAMES SHEPPARD and HENRY FRANKLIN ADAMS, Montreal,, Quebec, Canada.

1,002,465. ENGINE-STARTING DEVICE. GREGORY J. SPOHRER, Franklin, Pa.

1,002,521. VACUUM-CLEANER. FRANK KENNEY, Portland, Oreg.

1,002,556. PNEUMATIC ELEVATOR. GEORGE BERNERT and JACOB BERNERT, South Germantown, Wis.

1,002,570. TREATMENT OF PETROLEUM. JESSE A. DUBBS, Santa Monica, Cal.

The method of treating petroleum to dry, and free the same from water, distil or produce asphalt therefrom, consisting in continuously causing the petroleum to drop, *in vacuo*, in the presence of ascending currents of combustion gases to drive off the lighter products from each of said drops while in suspension and collecting the asphaltic residuum below the heat zone, the size of the drops being varied according to the ascending heat and to the product desired.

1,002,576-7-8. APPARATUS FOR DRYING AIR BY REFRIGERATION. JAMES GAYLEY, New York, N. Y.

1,002,618. AIR-FILTER. HUBERT WINKLER, Moscow, Russia.

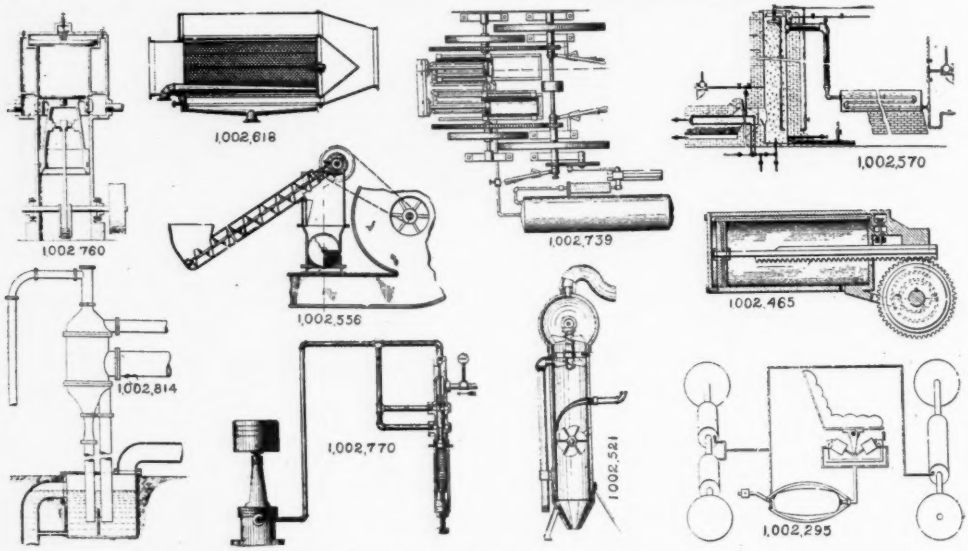
1,002,739. COMPRESSED-AIR ENGINE. DICK H. MURRAY, Houston, Tex.

1,002,760. AIR-COMPRESSOR. EDWARD A. RIX, San Francisco, Cal.

1. In an air compressor, the combination with a cylinder having an eduction valve at its upper end and two annular series of inlet ports at an intermediate point, spaced apart longitudinally of the cylinder, of a crank shaft, a connecting rod and a piston movable downwardly to open the upper series of inlet ports above the piston and having a peripheral air chamber open to the inlet ports in all positions of the piston when the inlet ports are not open to cylinder, whereby the inlet ports are never closed by the piston, and an upwardly opening valve in the piston through which air passes from the peripheral chamber to the cylinder.

1,002,770. UNLOADING DEVICE FOR COMPRESSORS. CARL G. SPRADO, Milwaukee, Wis.

1,002,814. BAROMETRIC CONDENSER. ROYAL D. TOMLINSON, Milwaukee, Wis.




PNEUMATIC PATENTS, SEPTEMBER 5

SEPTEMBER 12.

1,002,821-2-3. PNEUMATIC SPRING DEVICE. IRVING COWLES and ERNEST H. MACDOWELL, South Haven, Mich.

1,002,905. HUMIDIFYING APPARATUS. ALBERT J. DRONSFIELD, Providence, R. I.

1,002,917. LUBRICATOR. STARKY DANIEL JONES, Georgetown, Colo.

1,002,943. AIR-ENGINE PLANT. MAGLOIRE THIBAULT and MICHAEL SAMWOLD, Ottawa, Ontario, Canada.

1,002,971. COMBINED SPEED-REGULATING AIR-CUSHION AND EMERGENCY JARRING DEVICE. ROBERT M. DOWNIE, Beaver Falls, and JAMES L. DOWNIE, Downieville, Pa.

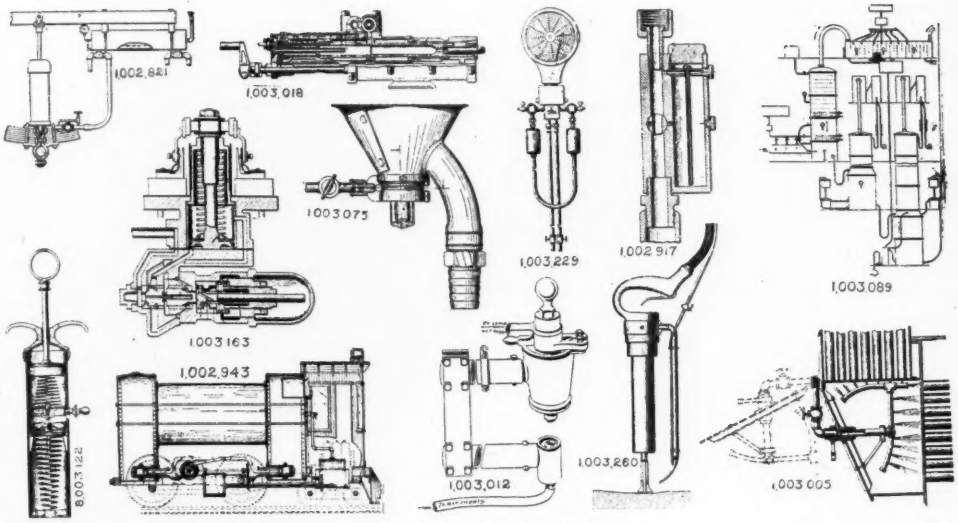
1,003,005. BLOWER FOR BOILERS. ALFRED G. MATTSSON, Detroit, Mich.

1,003,012. RIVETING AND CALKING MACHINE. CLARK J. SMITH, Ottumwa, Iowa.

1,003,018. DRILLING-MACHINE. DANIEL SHAW WAUGH, Denver Colo.

1,003,075. DUST-COLLECTOR FOR ROCK-DRILLS. CHARLES SOLOMON WAHLSTROM, Wallstreet, Colo.

1,003,089. APPARATUS FOR RECOVERING SOLVENT VAPORS FROM AIR, &c. AN-




PNEUMATIC PATENTS, SEPTEMBER 12

TOINE COLLARD, Molenbeek, near Brussels, Belgium.

1,003,122. AIR-PUMP. IRA PASLEY, Olds, Alberta, Canada.

1,003,129. AIR-COOLING APPARATUS. FREDERICK WITTENMEIER, Chicago, Ill.

1,003,154. PNEUMATIC HAMMER. ROBERT T. SCOTT, Chicago, Ill.

1,003,163. PRESSURE-GOVERNOR FOR PUMPS. WALTER V. TURNER, Edgewood, Pa.

1,003,229. DIFFERENTIAL-PRESSURE GAGE. WILLIAM H. BRISTOL, Waterbury, Conn.

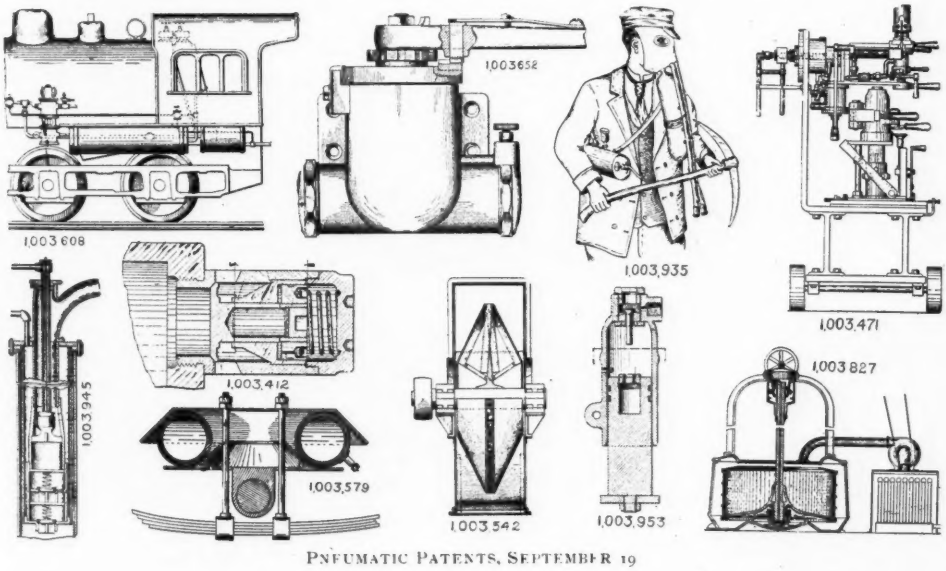
1,003,260. DUST PREVENTER FOR STONE-WORKING-TOOLS. WILLIAM H. HOLDEN and EDWARD M. TOBIN, Barre, Vt.

1,003,279. PNEUMATIC PIANO-PLAYER. WILLIAM GIFFORD MCARTHUR, New York, N. Y.

SEPTEMBER 19.

1,003,312-3. VALVE. CHARLES R. BALLARD, Midway, Pa.

1. A self contained valve for compressors, pumps and the like, comprising a casing provided at its inner end with a valve seat and with means for attachment to the cylinder and having ports in its side walls and provided with an internal shoulder, a valve co-operating with the valve seat and provided with an outwardly extending stem, a bushing rotatably adjustable in said casing and provided with an axial bore in which the valve stem is slidable and with an enlarged part contacting directly with the shoulder in the casing, a valve cap threaded into




PNEUMATIC PATENTS, SEPTEMBER 19

and closing the outer end of said casing and bearing directly against the bushing and clamping the latter against the internal shoulder in the casing, and a spring arranged to hold said valve to its seat.

1,003,471. MACHINE FOR MANUFACTURING GLASS BOTTLES, JARS AND THE LIKE. FREDERICK WILLIAM KNOWLES and GEORGE WILLIAM INMAN, Thornhill Lees, near Dewsbury, England.

1. A glass blowing machine comprising a rotatable frame, a divisable parison mold and an air cylinder mounted on the frame, mechanism operated from the cylinder for separating the mold, an air supply pipe connected with the blowing shell of the molds, a pressure pipe communicating with an annular passage formed in the journal of the frame, and conduits connecting the annular passage with the air cylinder.

1,003,542. CENTRIFUGAL PUMP OR BLOWER. JOSEPH J. STOETZEL, Chicago, Ill.

1,003,579. PNEUMATIC CUSHION FOR VEHICLES. GEORGE J. BANCROFT, Denver, Colo.

1,003,603. TRAIN-HEATING SYSTEM. WILLIAM JOHN HATCH, Montreal, Quebec, Canada.

1,003,651-2-3. DOOR-CHECK. JOSEPH CHARLES REGAN, Stamford, Conn.

1,004,020. GLASS-BLOWING MACHINE. LUDWIG GROTE, London, England.

1,004,043. AUTOMATIC AIR-TORPEDO. OTTO A. LANGOS, Chicago, Ill.

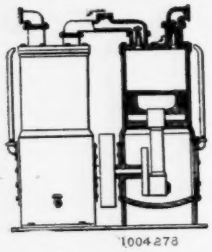
1. An automatic air torpedo, comprising a cylinder having an outlet port, means adapted to clamp the ribbon onto said port, means adapted to compress air in the cylinder and burst the ribbon above the port, and means for automatically feeding the ribbon across the port.

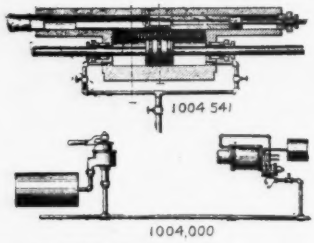
1,004,110-1. PRESSURE-CONTROL APPARATUS FOR FLUID PRESSURE BRAKES. WALTER V. TURNER, Edgewood, Pa.

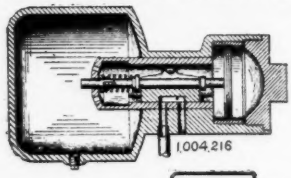
1,004,177. TRACK-SANDER FOR LOCOMOTIVES. RICHARD KETT, Denver, Colo.

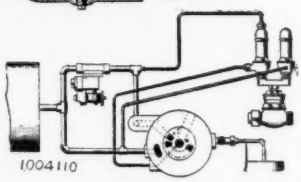
1. In a track sander, the combination with a sand receptacle, means for supplying air to the receptacle under pressure, and a tube in communication with the source of air supply and extending upwardly into the receptacle and having its upper extremity bent downwardly for initially discharging air into the receptacle for sand agitating purposes, and conduits connected with the receptacle for delivering sand to the track rails, substantially as described.

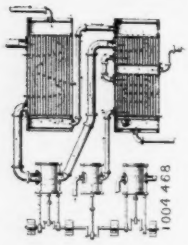
1,004,213. DEVICE FOR REGULATING THE

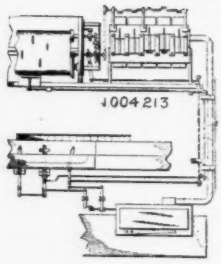


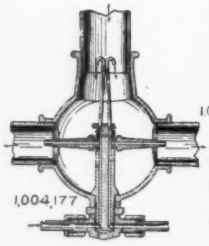



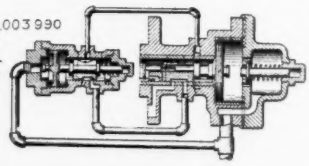




PNEUMATIC PATENTS, SEPTEMBER 26

1,003,661. WIND-MOTOR. CHARLES E. SHAFFER, Morrill, Nebr.

1,003,827. ART OF DRYING AND POLISHING. FREDERICK A. TOLHURST, New York, N. Y.

1,003,935. COMBINED RESPIRATOR AND PRESSURE EQUALIZER. WILLIAM F. MERRYMAN, Denver, Col.

1,003,945-6. PNEUMATIC WATER-ELEVATOR. BENJAMIN R. PILCHER, Dothan, Ala.

1,003,953. BELL-RINGER. FRANK SIMONS, St. Louis, Mo.

SEPTEMBER 26.

1,003,990. RETARDED-RELEASE VALVE. JOHN S. CUSTER, Pittsburgh, Pa.

1,004,000. FLUID-PRESSURE BRAKE DEVICE. EDWIN A. EMERY, St. Louis, Mo.

1. In a fluid pressure brake, the combination with a brake cylinder and means for charging the air in the brake system with a lubricant, of means for conveying the exhaust air from the brake cylinder to the chamber at the non-pressure side of the brake piston.

1,004,006. RAIL-LUBRICATOR. FRANK S. FREEMAN and FRED L. DOKE, Corsicana, Tex.

1,004,016. PNEUMATIC CONTROL DEVICE. LELAND F. GOODSPEED, Milwaukee, Wis.

SPEED OF PNEUMATIC MOTORS. LOUIS W. SOTHGATE, Worcester, Mass.

1,004,216. AUTOMATIC RETAINER. EDWIN M. SWIFT, Seattle, Wash.

1,004,257-8-9. PROCESS OF MANUFACTURING GLASS VACUUM-WALL BOTTLES. ORLANDO J. W. HIGBEE, Pittsburgh, Pa.

1,004,278. AIR-PUMP. DANIEL KLEIN, Spokane, Wash.

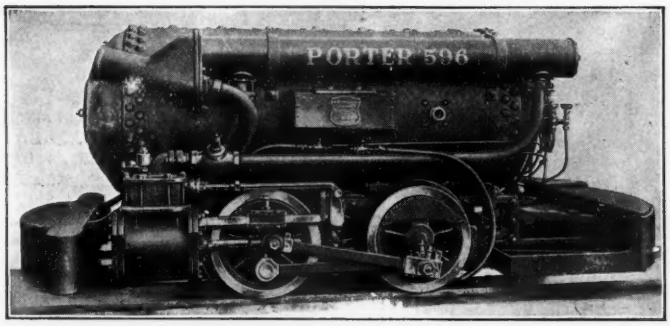
1,004,468. METHOD OF DRYING AIR. IRVING H. REYNOLDS and FRED E. NORTON, Youngstown, Ohio.

1. The method of extracting moisture from air, which consists in compressing the air; bringing the same while in its compressed state into contact with a surface the temperature of which is materially lower than that of the air and thereby causing the contained moisture to condense; permitting the dried air to expand and by reason of its expansion to lower its temperature; and finally employing the cold air thus obtained to lower the temperature of the medium employed to cool the aforesaid cooling surface.

1,004,504. VACUUM-CLEANER. LUTHER VAN NETTE, Bradford, Pa.

1,004,541. FLUID-PRESSURE CONTROL. FREDERICK E. MARTIN, Bonami, La.

# PORTER COMPRESSED AIR
## MINE AND INDUSTRIAL HAULAGE




A Two-Stage Compressed Air Gathering Locomotive—one of twenty built for the Pittsburg-Buffalo Company. Wireless, Sparkless. Two-stage features add fifty per cent. to the efficiency and reduce the cost of installation, making our air haulage the most economical as well as the safest, cleanest, handiest and most dependable mine haulage in the world.

Address **H. K. PORTER COMPANY, 1207 Union Bank Bldg., Pittsburg, Pa.**

# LOCOMOTIVES
## OF EVERY DESCRIPTION

## Compressed Air Locomotives

**for Mine and Industrial Service**

The Baldwin Locomotive Works
PHILADELPHIA, PA., U. S. A.
Cable Address—"BALDWIN PHILADELPHIA"

DO you realize that the publisher of one journal gets closer to his trade than the publisher who gets out a string of papers? The "syndicate" publisher cannot possibly get in close touch with his clientile, and the personal element is a powerful influence in the trade journal field.

This personal element has a lot to do with the pulling power of a publication. The Black Diamond's Publisher has only one journal to look after, which is probably the reason why it has maintained its position as the coal trade's leading journal for the last 25 years. It has proved to be a profitable medium for advertisers wishing to reach the coal industry.

LET US QUOTE YOU RATES.

THE BLACK DIAMOND

CHICAGO Manhattan Building
NEW YORK, 29 Broadway.
PITTSBURGH, 1502 Oliver Building.
COLUMBUS, 509 Brunson Building.

## McNab & Harlin Manufacturing Co.

Your attention is called to the fact, that we have for many years been specialists in the manufacture of EXTRA HEAVY, HIGH PRESSURE and HYDRAULIC VALVES AND FITTINGS, and are especially equipped to turn out the goods in the most satisfactory manner, very promptly

You will find these fittings illustrated in our 1909, 10th edition catalog, copy of which we will be pleased to send upon request.

All of our valves are thoroughly tested and inspected before leaving our factory.

We solicit your orders and inquiries.

OFFICE AND SALESROOMS 50-56 John St., N. Y.

FACTORY Paterson, N. J.

### CLASSIFIED BUYERS' GUIDE

**Air Cylinder Oil.**
Atlantic Refining Co.
Borne, Scrymser Co.
Chicago Pneumatic Tool Co.
Continental Oil Co.
Fiske Bros'. Refining Co.
Galigher Machinery Co.
Standard Oil Co.
Vacuum Oil Co.

**Air Lift Pumps.**
Chicago Pneum. Tool Co.
Curtis & Co., Mfg. Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
Westinghouse Air Brake Co.

**Air Gauges.**
Galigher Machinery Co.
McKiernan-Terry Drill Co.
Westinghouse Air Brake Co.

**Air Receivers.**
Baldwin Locomotive Works, The
Bury Compressor Co.
Chicago Pneum. Tool Co.
Curtis & Co., Mfg. Co.
Gardner Compressor Mfg. Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Janney, Steinmetz & Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
Pangborn Co., Thomas W.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.
Westinghouse Air Brake Co.

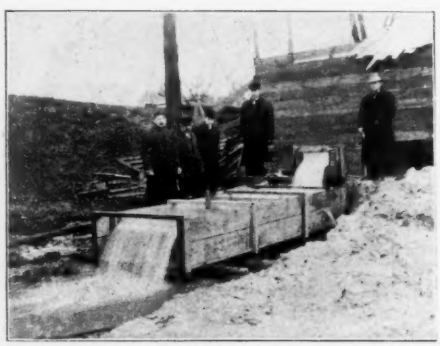
**Air Tanks.**
Baldwin Locomotive Works, The
Bury Compressor Co.
Chicago Pneum. Tool Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Janney, Steinmetz & Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
Pangborn Co., Thomas W.
Porter Co., H. K.
Westinghouse Air Brake Co.

**Aftercoolers, Air.**
Bury Compressor Co.
Chicago Pneum. Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Belting.**
Republic Rubber Co.

**Belt Dressings.**
Jos. Dixon Crucible Co.

**Blowers.**
Cameron Stm. Pump Wks, A.S.
Chicago Pneumatic Tool Co.
Galigher Machinery Co.



## The 20th Century Air-Lift

Space will not allow us to illustrate all wells we have pumping with our equipment, so we are pleased to give you some figures that will be of interest on the WELL, which is shown herewith under pumping conditions.

The water from this well is discharged under our umbrella well top and flows into the weir box where it is accurately measured.

**Size of Well 10 in. Size of Water Discharge 6 in. Depth of Well 800 ft Pumping Level 50 ft. Rated Capacity of Pump, 800 gallons per min. Gallons being delivered over weir 1296 per min.**

**WE ALWAYS EXCEED OUR GUARANTEE.**

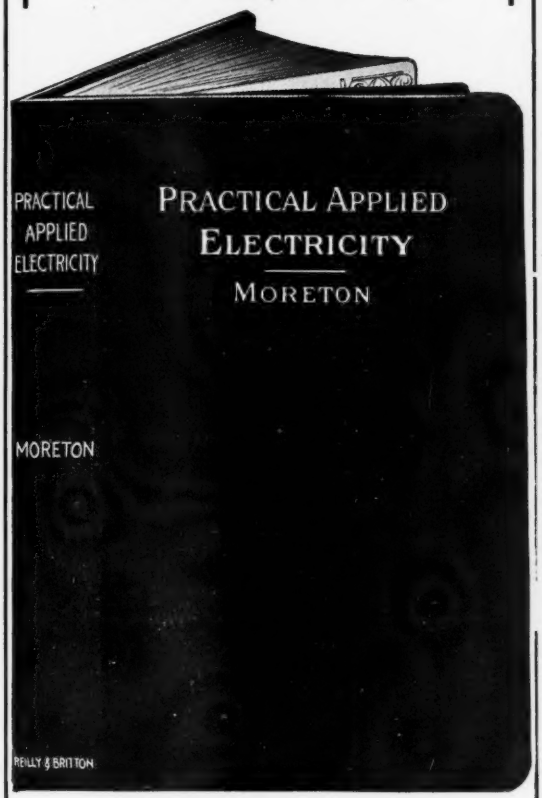
The absence of all obstructing mechanism in the well allows each well to operate to its entire capacity.

**Every Plant Installed Under Guarantee.**

## Harris Air-Pump Company

**INDIANAPOLIS, INDIANA**

# A Book That Tells HOW and WHY




This Book is the Best Pocket

## Electrical Encyclopedia

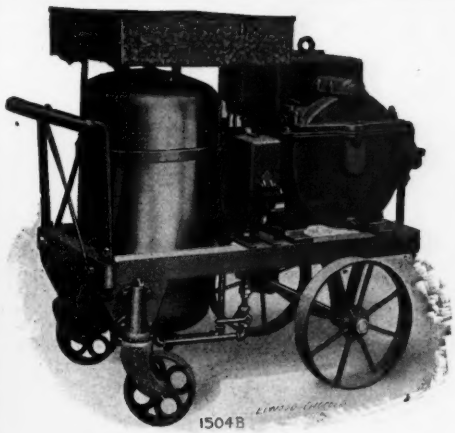
Covering every line of electrical appliances and best for the **practical electrician.**

**450 Pages** **Freely Illustrated**
**Price, $2.00 (8s) Net**

**For Sale by**

## The Compressed Air Magazine Co.

**11 Broadway :: New York**




TYPE "H-2" PORTABLE OUTFIT

## The Importance of Proper Design

Permanent air compressor satisfaction depends, primarily, on proper design

For no matter how excellent the quality of materials used in its construction, nor the care with which the individual parts are assembled, the design of the entire unit must be right, to insure the longest term of efficient service.

### National Compressors
**Motor Driven**

are designed right and built right. They represent more than fifteen years of specialized effort in air compressor manufacture and have an enviable record for steady, consistent service in many fields of industry.

They are efficient, economical units and operate for long periods with very little attention or repairs.

We furnish them in portable and stationary types, with electric or gas motor, or belt drive, as desired. The capacities range from 11 to 350 cubic feet of free air per minute.

Write today for descriptive literature.

*Address Department S*

## National Brake & Electric Co.

**Milwaukee - - Wis.**

NEW YORK, 111 Broadway.
CHICAGO. 1344 First Nat'l Bank Bldg.
PITTSBURG, 9th and Penn Ave.
ST. LOUIS, 405 Security Bldg.
LONDON, ENG., 14 Great Smith St.

# JEWETT

## Machinery Illustrators

PHOTO-ENGRAVERS
CATALOG DESIGNERS

**29 Broadway**
**New York**

WHY NOT USE THE
**POWELL Air Gun Valve**

Blows your work bench, machine tool, in fact everything, perfectly clean. Operation is another case of "Press The Button." Order a sample.

**The Wm. Powell Co., Cincinnati, O.**

**TANKS** For Air Pressure, Oxygen and Hydrogen

**Gasoline Tanks**

For Automobiles and Motor Boats a Specialty
Write for new Price List

SEAMLESS STEEL SHELLS AND SHAPES

TANKS TANKS

SPECIALS TO ORDER

LEAKLESS-RIVETLESS

JANNEY, STEINMETZ & CO., - PHILADELPHIA

BRANCH—NEW YORK


**Blowing Engines.**
Cooper Co., C. & G.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.

**Brakes, Air.**
National Brake and Electric Co.
Westinghouse Air Brake Co.

**Catalogue Designers.**
Jewett

**Channelers.**
Galigher Machinery Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Charging Stations.**
Baldwin Locomotive Works.
Porter Co., H. K.

**Coal Cutters.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Coal and Ore Elevator Buckets.**
Clark Co., W. J.
Galigher Machinery Co.

**Compressors, Air and Gas.**
Bury Compressor Co.
Chicago Pneum. Tool Co.
Curtis & Co., Mfg. Co.
Galigher Machinery Co.
Gardner Compressor Mfg. Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
National Brake and Electric Co.
Pangborn Co., Thomas W.
Powell Co., Wm.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.
Westinghouse Air Brake Co.

**Compressor Fittings, Air and Gas.**
Chicago Pneum. Tool Co.
Galigher Machinery Co.
Gardner Compressor Mfg. Co.
Mason Regulator Co.
Powell Co., Wm.
Republic Rubber Co.

**Compressor Regulators.**
Chicago Pneum. Tool Co.
Gardner Compressor Mfg. Co.
Mason Regulator Co.

**Core Drills, Diamond.**
Sullivan Machinery Co.

**Core Drills, Diamondless.**
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Core Making Machinery.**
Pangborn Co., Thomas W.

**Corliss Engines.**
Cooper Co., C. & G.
Galigher Machinery Co.
Sullivan Machinery Co.

**Drilling Machines, Pneumatic.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Pangborn Co., Thomas W.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Drill Sharpeners.**
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
T. H. Proske.

**Dust Exhaust and Collector Systems.**
Pangborn Co., Thomas W.

**Electro-Pneumatic Machinery.**
Galigher Machinery Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

**Engine Room Appliances.**
Galigher Machinery Co.

**Fans, Ventilating.**
Galigher Machinery Co.
Sullivan Machinery Co.

**Foundry Appliances.**
Chicago Pneumatic Tool Co.
Curtis & Co., Mfg. Co.
Ingersoll-Rand Co.
Pangborn Co., Thomas W.

**Foundry Facings.**
Jos. Dixon Crucible Co.

**Graphite Commutator Brushes.**
Jos. Dixon Crucible Co.

**Graphite Crucibles and Retorts.**
Jos. Dixon Crucible Co.

**Graphite Greases.**
Galigher Machinery Co.
Jos. Dixon Crucible Co.

**Graphite Paint.**
Galigher Machinery Co.
Jos. Dixon Crucible Co.

**Hammer Drills.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Hammers, Calking and Chipping.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Pangborn Co., Thomas W.
Stearns-Roger Mfg. Co.

**Hammers, Riveting.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Pangborn Co., Thomas W.
Stearns-Roger Mfg. Co.

**Helmets, Sand Blast.**
Pangborn Co., Thomas W.

# Brown & Seward

EDWARD C. SEWARD ROBERT B. SEWARD

E. CLARKSON SEWARD

## PATENTS

and

## PATENT CAUSES

OFFICES:

261 Broadway : : NEW YORK

# COMPRESSED AIR

**Theory and Computations**

*An Engineer's Handbook*

**By ELMO G. HARRIS, C. E.**

The book is thorough and accurate. As a mathematical book it is made valuable by full charts, tables, formulas and problems. Brief and concise, it might well be regarded as an engineer's handbook on this important subject.

**136 pages, 6 x 9, illustrated, $1.50 (6s 6d) net, postpaid.**

FOR SALE BY

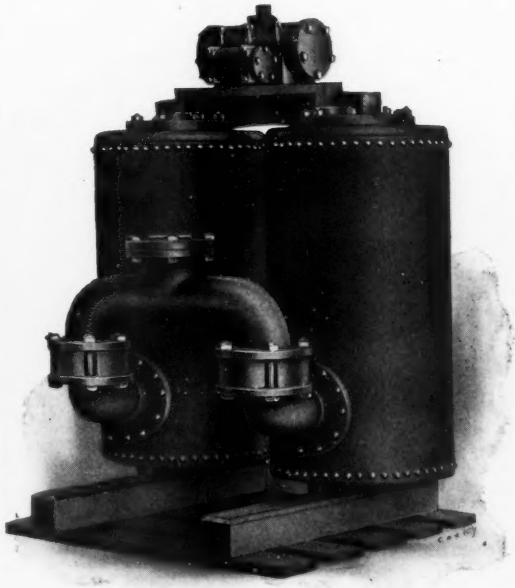
**The Compressed Air Magazine Co.**

**11 Broadway, New York City**

# The Latta-Martin Pneumatic Displacement Pump

## FOR LONG-DISTANCE PUMPING

**Sold Under an Absolute Guarantee**



The Culmination of 15 Years' Experience

Has no pistons or plungers to cut or wear out requires no lubrication. Handles muddy or gritty water without injury.

Utilizes power at plant and pumps water from any distance—no independent pumping station necessary.

Have been sold with repeat orders from the U S. Government, the British Government, State Governments, of New York, Indiana, Maryland and many of the largest railway systems and manufacturing plants in the world. Handles water, oils, acids, sewage, marl, slurry and all silicious mixtures. For mines and quarries it has peculiar advantages over all other methods of pumping.

The manufacturers have built and sold more than ten times as many displacement pumps as all other displacement pump builders of the world combined.

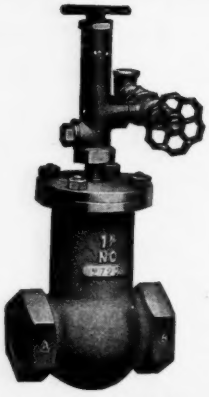
## Latta-Martin Pump Co.

**Hickory, N. C., U. S. A.**

## THE ERIE UNLOADER—NEW STYLE

**For Single, Duplex and Multiple Stage Steam, Belt or Electric Driven**

## AIR COMPRESSORS



Maintains practically a constant air pressure, whatever the requirement. Completely unloads and loads Compressor without shock or strain.
Circulars on application to

**JARECKI MFG. CO., - ERIE, PA.**

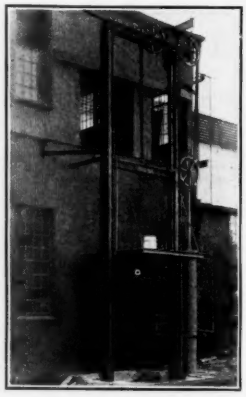
ALSO COMPRESSOR GOVERNORS

## More Economical Than Steam, Hydraulic or Electric

Lower in First Cost
Lower Maintenance Cost
Lower Operating Cost

*REASONS WHY:*

**THE CURTIS PNEUMATIC ELEVATORS** are simpler and have fewer parts, have no gears, no belts, no motors, no pulleys, no steam to condense, are not effected by heat, cold, dirt or dampness, need no repairs and require no skilled operator. They cannot overtravel and wreck themselves or drop through overloading or failure of air supply. Are fireproof and practically foolproof.



*For details, write for Circular B-1.*

*Put 'em anywhere*

**Curtis Mfg. Co.**
**1590 Kienlen Ave.**
**ST. LOUIS, MO.**


**Hoisting Machinery.**
Galigher Machinery Co.
Lidgerwood Manuf. Co.
Sullivan Machinery Co.

**Hoists, Air.**
Chicago Pneumatic Tool Co.
Curtis & Co., Mfg. Co.
Galigher Machinery Co
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.

**Hose Coupling and Clamps.**
American Metal Hose Co.
Chicago Pneumatic Tool Co.
Clark Co., W. J.
Cleveland Pneumatic Tool Co.
Curtis & Co., Mfg. Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Sprague Electric Co.
Sullivan Machinery Co.
Westinghouse Air Brake Co.

**Hose, Sand Blast.**
Pangborn Co., Thomas W.

**Hose, Steam and Air.**
American Metal Hose Co.
Chicago Pneumatic Tool Co
Curtis & Co., Mfg. Co.
Galigher Machinery Co.
Goodrich Co., The B. F.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Republic Rubber Co.
Sprague Electric Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**njectors.**
Penberthy Injector Co.

**Locomotives, Compressed Air.**
Baldwin Locomotive Works, The
Galigher Machinery Co.
Porter Co., H. K.

**Lubricating Graphite.**
Jos. Dixon Crucible Co.
Galigher Machinery Co.

**Lubricating Greases.**
Borne, Scrymser Co.
Fiske Bros'. Refining Co.
Galigher Machinery Co.

**Lubricating Oils.**
Atlantic Refining Co.
Borne, Scrymser Co.
Continental Oil Co.
Fiske Bros'. Refining Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
Standard Oil Co.
Vacuum Oil Co.

**Lubricators.**
Powell Co., Wm.

**Magnetic Separators.**
Pangborn Co., Thomas W.

**Meters, Air.**
Ingersoll-Rand Co.
Metric Metal Works.
St. John, G. C.

**Mining Machinery.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Motors, Air and Gas**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
National Brake and Electric Co.
Stearns-Roger Mfg. Co.

**Nozzles, Air and Sand.**
Curtis & Co., Mfg. Co.
Pangborn Co., Thomas W.

**Oil Cups.**
Galigher Machinery Co.
Powell Co., Wm.

**Ore Concentrating Machinery.**
Galigher Machinery Co.
Stearns-Roger Mfg. Co.

**Photo-Engravers**
Jewett.

**Pile Drivers, Pneumatic.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.

**Pipe Joint Compound.**
Galigher Machinery Co
Jos. Dixon Crucible Co.

**Plug Drills.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Pumping Systems, Pneumatic.**
Bury Compressor Co.
Curtis & Co., Mfg. Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.

**Pumps, Air.**
Cameron Stm. Pump Wks, A. S.
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Westinghouse Air Brake Co.

**Pumps, Pneumatic Displacement.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Harris Air Pump Co.
Ingersoll-Rand Co.
Latta-Martin Pump Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Westinghouse Air Brake Co.

**Pumps, Steam.**
Cameron Stm. Pump Wks, A. S.
Galigher Machinery Co.
Stearns-Roger Mfg. Co.
Westinghouse Air Brake Co.

**Quarry Machinery.**
Bury Compressor Co.
Cameron Stm. Pump Wks, A. S.
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.

SELF-DRAINING

TRADE PENBERTHY MARK

RE-STARTING

# AUTOMATIC INJECTORS

25 years' experience in injector construction has made the Penberthy Automatic the world's most efficient boiler feeder.

Over 625,000 of these injectors have been made and sold during the last quarter century.

*A copy of our new magazine "Injector Talks," will be sent free.*

**PENBERTHY INJECTOR CO.** **Detroit, Mich., U. S. A.**

SECOND EDITION, REVISED AND ENLARGED

# COMPRESSED AIR PLANT

THE PRODUCTION, TRANSMISSION AND USE OF COMPRESSED AIR, WITH SPECIAL REFERENCE TO MINE SERVICE

## By ROBERT PEELE

*Mining Engineer and Professor of Mining in the School of Mines, Columbia University*

As compared with the first edition the size of the second edition is increased 174 pages and the illustrations increased 97 figures. The price is advanced from $3.00 (12s 6d) net) to $3.50 net (15s net).

**For sale by The Compressed Air Magazine Co., 11 Broadway, New York City**

Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Reducing Valves.**
Mason Regulator Co.

**Rock Drills, Air and Steam.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Rock Drills, Electric-Air.**
Galigher Machinery Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

**Sand Blast Machinery.**
Curtis & Co., Mfg. Co.
Ingersoll-Rand Co.
Pangborn Co., Thomas W.

**Sand Blast Systems.**
Pangborn Co., Thomas W.

**Sand Handling and Conveying Machinery.**
Pangborn Co., Thomas W.

**Sand Riddling Machines.**
Chicago Pneumatic Tool Co.
Pangborn Co., Thomas W.

**Stone Tools, Pneumatic.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.
Sullivan Machinery Co.

**Tools, Pneumatic.**
Chicago Pneumatic Tool Co.
Galigher Machinery Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Oldham & Sons Co., Geo.
Pangborn Co., Thomas W.
Stearns-Roger Mfg. Co.

# The "OLDHAM" SHIPPING HAMMER

combines efficiency, durability and simplicity; consequently is

**"The Ultimate Tool"**

where these salient features are recognized

**Geo. Oldham & Son Company, FRANKFORD, PHILA., Pa.**

Manufacturers of Pneumatic Tools and Appliances.

Tell the Advertiser You Saw His Ad. in COMPRESSED AIR MAGAZINE.

**DRILLS**—ROCK—HAMMER—CORE
—FOR ALL CLASSES OF WORK—

**AIR COMPRESSORS**

FOR FULL PARTICULARS WRITE

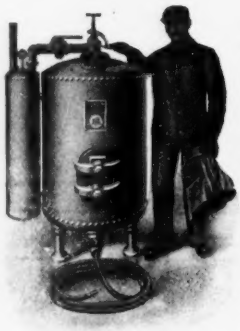
**McKIERNAN-TERRY DRILL CO.**

115 BROADWAY, NEW YORK CITY

# OVER 500 PLANTS

**Are Making Bigger Profits Every Day by Using**

**PANGBORN HIGH PRESSURE SAND-BLAST**



If the character and volume of your output, in our judgement, will make it PAY YOU, we'll send it to you, have one of our Sand-Blast Instructors start it off, and teach your men how to use it.

Then, after 10 days trial, if you are not fully satisfied that you need it, and it will PAY YOU WELL, send it back! The trouble and expense are ours!

"If the INVESTMENT don't pay you—the SALE don't pay us."

THOMAS W. **PANGBORN** COMPANY

JERSEY CITY

Works and Showrooms: 56 Hudson Street

**SAND-BLAST SPECIALISTS**

For the Lubrication of Air Compressors

## OILS OF SUPERIOR QUALITY

Are Required.

# "Aeroil" and "Paragon"

**AIR COMPRESSOR OILS**

Are Superior Oils.

**AIR and STEAM DRILL OILS**

**CYLINDER and VALVE OILS**

*MADE BY*

# BORNE, SCRYMSER COMPANY

80 South Street, NEW YORK

BOSTON FALL RIVER PHILADELPHIA

# *The* ST. JOHN

## INDICATING AND RECORDING

# AIR METER

Measures "All of the Air" at all Pressures and Temperatures.

SEND FOR BOOKLET

THE ACCURACY OF THIS METER IS GUARANTEED.

## G. C. ST. JOHN

**140 Cedar Street**

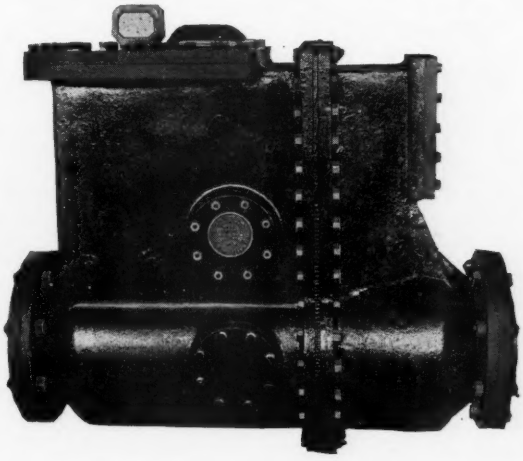
**New York**

# WESTCOTT AIR METER

## WITH SPONGE DIRT AND MOISTURE COLLECTOR

The Meter Dial indicates the exact amount of compressed air passed the meter since previous reading. :: ::

No computing of meter readings necessary.



In any volume up to 4,000 cu. ft. per minute. At any pressure up to 500 lbs to the square inch.

*WRITE FOR DESCRIPTIVE CIRCULAR*

— MANUFACTURED BY —

**Metric Metal Works, Erie, Pa.**

# "Chicago Giant"
# ROCK DRILLS
## Keller Stone Tools

**Surfacers**

**Plug Drills**

**Hammers, Etc.**

A full line of accessories.

SPECIAL PRICES ON CARVING TOOLS

Too well and favorably known to need special comment.

MANUFACTURED BY

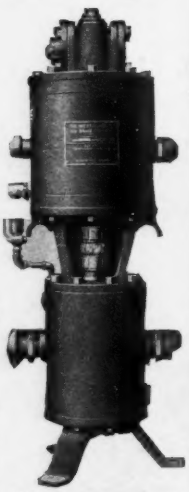
**CHICAGO PNEUMATIC TOOL COMPANY**

CHICAGO — Branches Everywhere — NEW YORK

# WESTINGHOUSE
## Air Compressors

The best small air compressors made for service where extreme simplicity, minimum weight, extraordinary durability and low maintenance cost are governing considerations. By modifying the standard sizes of air cylinders, a wide range of service is afforded.

**Our publication No. 9012 illustrates many interesting applications of Westinghouse Compressors, and contains valuable tables of useful information for users of compressed air. Send for it.**

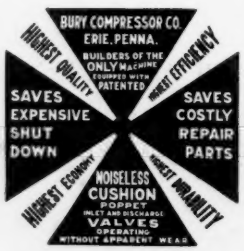


Westinghouse Portable Compressor. (Air Cylinder smaller than Steam Cylinder.) For High-Delivery Air-Pressures.

**The Westinghouse Air Brake Co.,**
**PITTSBURG, PA.**
New York Chicago St. Louis
Canada: Hamilton, Ontario.

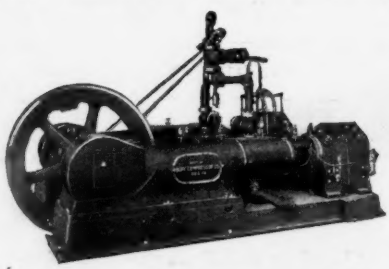
# A Noiseless Air Compressor

**A Triumph in Pneumatic Engineering.**


BURY COMPRESSOR CO.
ERIE, PENNA.
BUILDERS OF THE ONLY MACHINE EQUIPPED WITH PATENTED
HIGHEST QUALITY
HIGHEST EFFICIENCY
SAVES EXPENSIVE SHUT DOWN
SAVES COSTLY REPAIR PARTS
HIGHEST ECONOMY
HIGHEST QUALITY
NOISELESS CUSHION POPPET INLET AND DISCHARGE VALVES OPERATING WITHOUT APPARENT WEAR

**All Sizes. All Types. Built to meet any Engineering Requirements**

Cut below illustrates Bury Compound Air Duplex Steam Air Compressor equipped with Bury Patented Automatic Pneumatic Force Feed Oiling System.
**Most Simple, Most Perfect, Highest Quality Throughout**



**BURY COMPRESSOR CO., ERIE, PA.**
WE SOLICIT YOUR INQUIRIES.